Lower Fox River Waterway

HAER No. WI-83 HAER WIS 44-KAUK, 2-

The Lower Fox River Waterway begins in Menasha, Winnebago County, Wisconsin, and extends 37 miles through De Pere, Outagamie and Brown Counties to Green Bay, Wisconsin. However, for shelving purposes at the Library of Congress, Menasha in Winnebago County was selected as the "official" location for the Lower Fox River Waterway.

Menasha

Winnebago County

Wisconsin

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

HISTORIC AMERICAN ENGINEERING RECORD

LOWER FOX RIVER WATERWAY

HAER NO. WI-83

Location: The Lower Fox River Waterway is a 37 mile length of river extending from Menasha, to De Pere, Winnebago, Outagamie and Brown Counties, Wisconsin.

UTM:

	Description	UTM
1	Appleton Upper Dam	16/387180/4900820
2	Appleton Lower Dam	16/388919/4901300
3	De Pere Dam	16/415170/4921950
4	Cedars Dam	16/393700/4903600
5	Kaukauna Dam	16/398670/4903720
6	Little Kaukauna Dam	16/410450/4914200
7	Little Chute Dam	16/394850/4903140
8	Menasha Dam	16/384370/4894860
9	Rapid Croche Dam	16/404500/4907420

USGS Quadrangles: De Pere, Wisconsin 7.5' series; Kaukauna, Wisconsin 7.5' series: Neenah, Wisconsin 7.5' series; Wrightstown, Wisconsin 7.5' series

Date of Construction: 1850-1941

Engineer: United States Army Corps of Engineers with Contractors

Architect: United States Army Corps of Engineers with Contractors

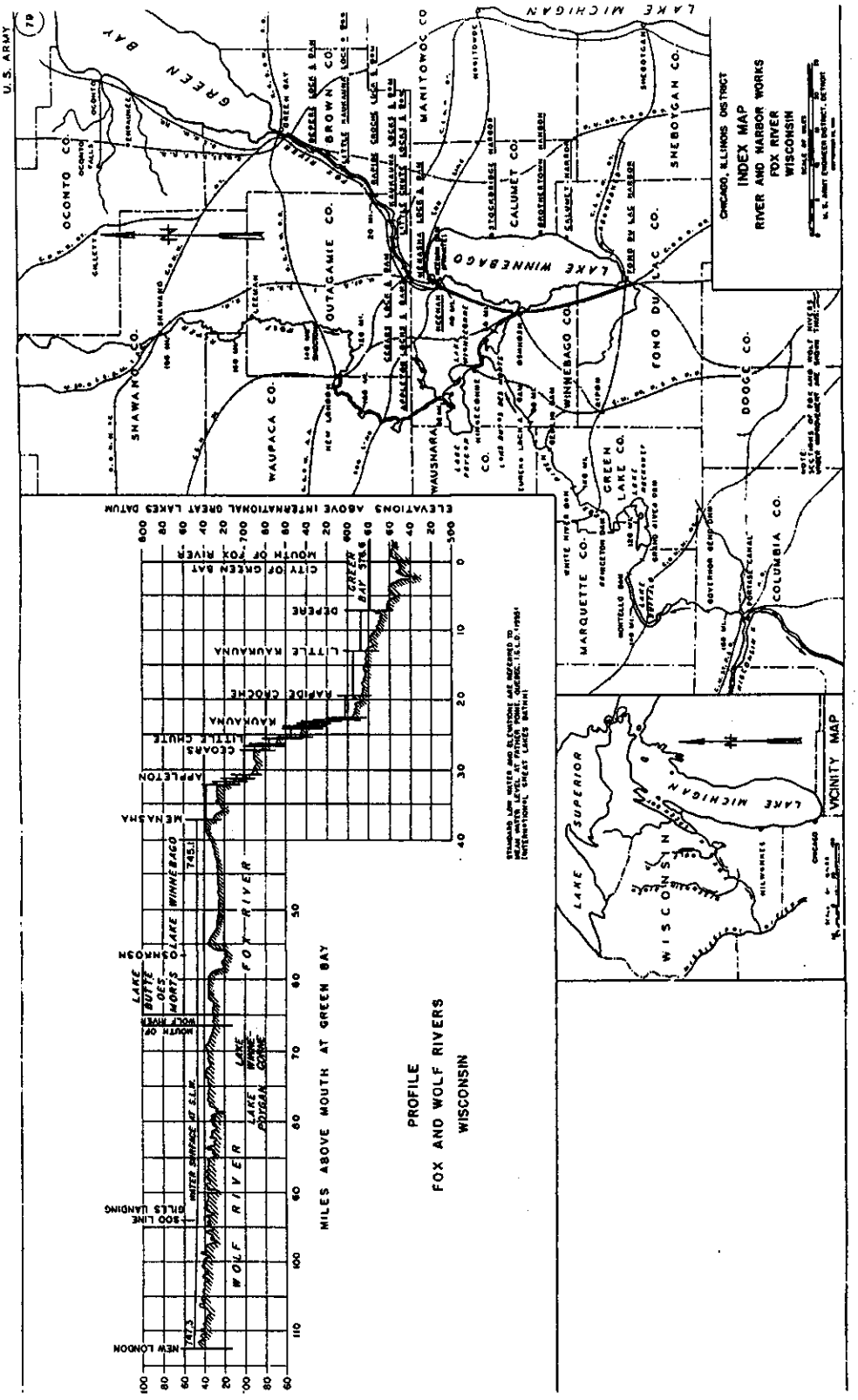
Present Owner: United States Army Corps of Engineers

Present Use: The Lower Fox River Waterway, held in caretaker status by the United States Army Corps of Engineers, is used by recreational boaters.

Significance: The Lower Fox River Waterway is significant as the State of Wisconsin's only existing canal system. Built to facilitate steamboat navigation, the system contains composite, quarried stone and concrete locks as well as dams and remains a remarkably well preserved example of the technology of canal construction.

Project Information: This documentation was undertaken in 1995 in accordance with requirements detailed in a June 19, 1994 letter from Gregory D. Kendrick, Chief, History Branch, NPS to Dale Monteith, Acting Chief, Planning Division, USACOE, Detroit District. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982. The USACOE plans to divest itself of the Lower Fox system as soon as is feasible; therefore, NPS requested this documentation. All documentation conforms to HAER standards.

Dr. John D. Richards, Principal Investigator; Georgia A. Lusk, Patricia B. Richards, and Robert J. Watson, Project Archivists with Great Lakes Archaeological Research Center, Inc.; Joseph Paskus, Project Photographer.


U.S. ARMY
INDEX MAP
RIVER AND HARBOR WORKS
FOX RIVER
WISCONSIN
VICINITY MAP
PROFILE
FOX AND WOLF RIVERS
WISCONSIN
MILES ABOVE MOUTH AT GREEN BAY
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GREEN BAY
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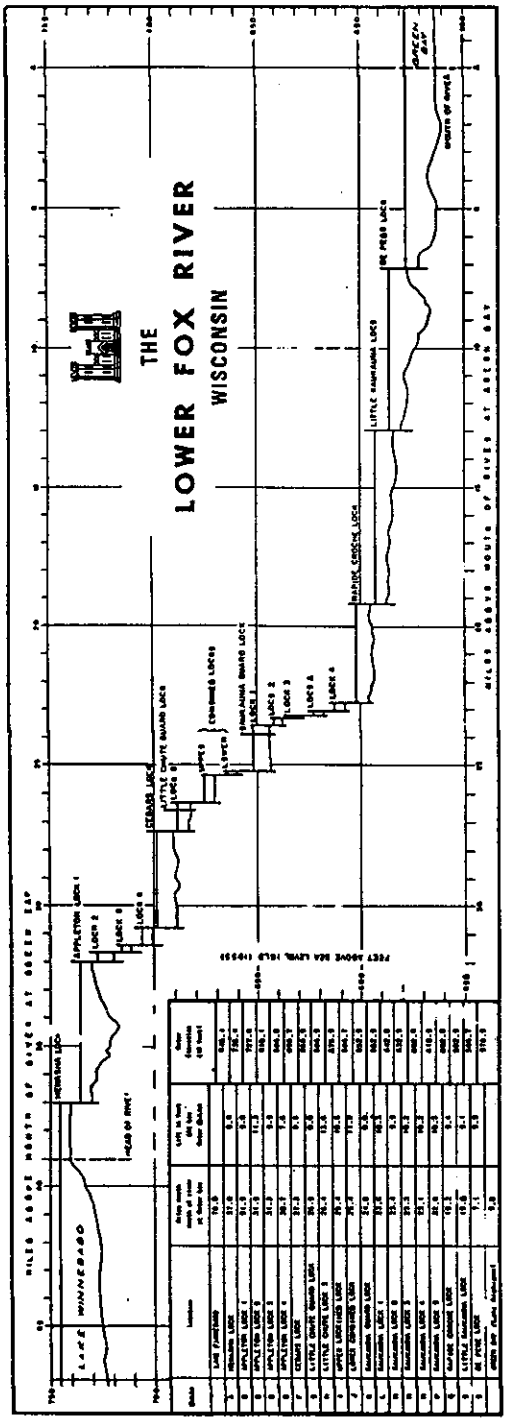
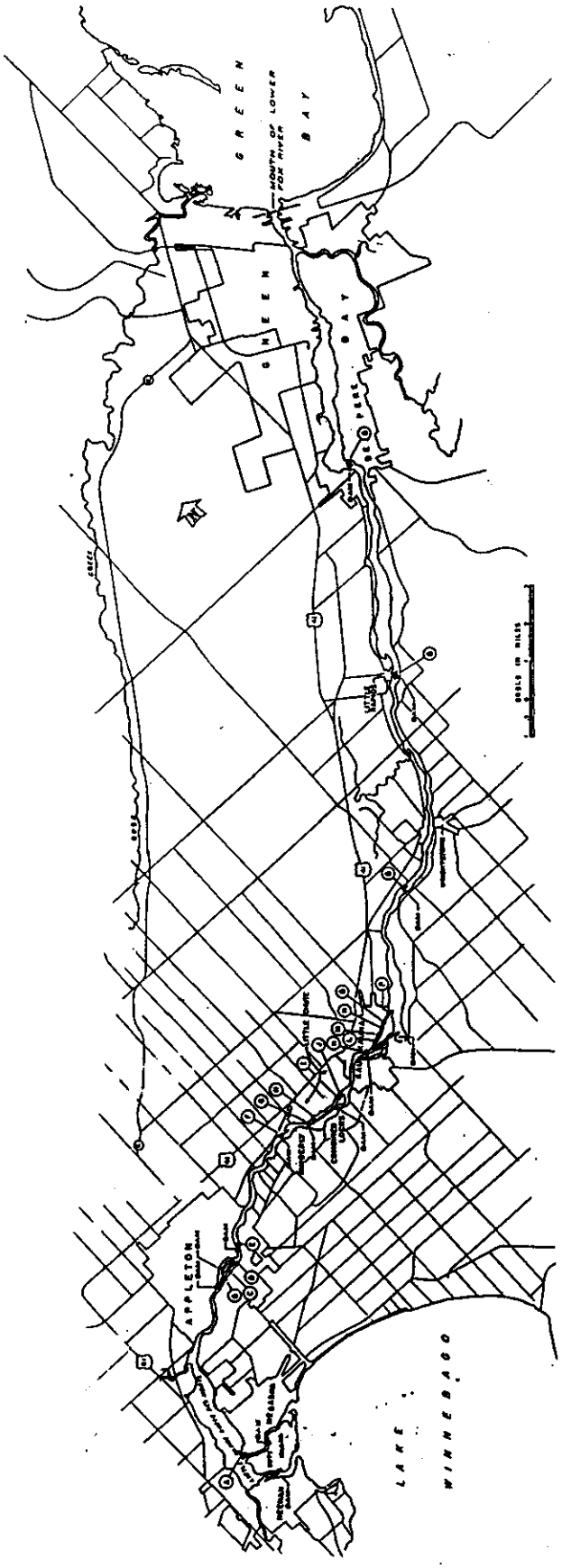
LAKE WINNEBAGO
LAKE SUPERIOR
WISCONSIN
OCONTO CO.
MARINETTE CO.
BROWN CO.
MANITOWOC CO.
SHEBOYGAN CO.
OUTAGAMIE CO.
CALUMET CO.
WAUPACA CO.
WINNEBAGO CO.
FOND DU LAC CO.
SHAWANO CO.
WAUSHARA CO.
GREEN LAKE CO.
DODGE CO.
MARQUETTE CO.
COLUMBIA CO.
CITY OF GREEN BAY
MOUTH OF FOX RIVER
DEPERE
LITTLE KAUKAUNA
KAUKAUNA
RAPIDE CROCHE
LITTLE CHUTE
CEDARS
APPLETON
MENASHA
NEENAH
WINNEBAGO
LAKE BUTTE DES MORTS
OSHKOSH
MOUTH OF WOLF RIVER
WATER SHED OF S.S.R.
LAKE POYGAN
LAKE WINNECONNE
WOLF RIVER
BULLS LANDING
500 LINE
NEW LONDON
FOX RIVER


THE
LOWER FOX RIVER
WISCONSIN
MILES ABOVE MOUTH OF RIVER AT GREEN BAY
FEET ABOVE SEA LEVEL, ISLD (1955)
LAKE WINNEBAGO
APPLETON LOCK 1
APPLETON LOCK 2
APPLETON LOCK 3
APPLETON LOCK 4
APPLETON LOCK 5
CROOKS LOCK
LITTLE CHUTE GUARD LOCK
UPPER DEPERE LOCK
LOWER DEPERE LOCK
KAUKAUNA LOCK 1
KAUKAUNA LOCK 2
KAUKAUNA LOCK 3
KAUKAUNA LOCK 4
KAUKAUNA LOCK 5
RAPIDE CROCHE LOCK
LITTLE KAUKAUNA LOCK
DE PERE LOCK
GREEN BAY
MOUTH OF RIVER


GREEN BAY
MOUTH OF LOWER FOX RIVER
DE PERE
APPLETON
LITTLE CHUTE
KAUKAUNA
LAKE WINNEBAGO

LOWER FOX RIVER WATERWAY

General Description

The Lower Fox River flows in a northeasterly direction from the city of Menasha draining the waters of Lake Winnebago and associated tributaries into Green Bay, a distance of 37 miles. The drop in elevation between the head of the river at Lake Winnebago and the river's mouth at Lake Michigan is 168.3 feet. This rather high degree of local relief made the uncontrolled Fox River a relatively wild and unnavigable river. The improved Lower Fox River Waterway includes 19 locks: 1 at Menasha, 4 at Appleton, 1 at Cedars, 4 at Little Chute, 6 at Kaukauna, 1 at Rapide Croche, 1 at Little Kaukauna and 1 at De Pere. The waterway also includes nine dams: the Menasha Dam; the Upper Dam at Appleton; the Lower Dam at Appleton; the Cedars Dam; the Little Chute Dam; the Kaukauna Dam; the Rapide Croche Dam; the Little Kaukauna Dam, and the De Pere Dam. A canal system comprised of eight individual canal segments was also constructed as part of the Lower Fox River Waterway. Ten lockkeeper's residences and other associated buildings including small lock shelters, garages, storage facilities and sanitary facilities are also associated with the Lower Fox River Waterway.

The Lower Fox River Waterway was originally part of the more extensive Fox-Wisconsin system designed to provide a navigable route between Lake Michigan port of Green Bay and the Mississippi River port of Prairie du Chien. The project was originally envisioned as consisting of four separate tasks: (1) the improvement of the Wisconsin River; (2) the construction of the Portage Canal, which would link the Wisconsin and the Fox River; (3) the improvement of the Upper Fox River through dredging, and (4) the improvement of the Lower Fox through the construction of a series of locks, dams and canals. However, economic realities forced the abandonment of attempts to improve the Upper Fox River by dredging; alternate plans calling for the construction of a system of locks and dams were developed in 1873. Similarly, attempts to improve the Wisconsin River failed by 1886.[1] However, the Portage Canal was completed in 1849 and the Lower Fox River system of locks and dams was operational by 1856. Nonetheless, the chronic commercial failure of the Fox-Wisconsin System forced abandonment of the Upper Fox system in 1958. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982.

UNITED STATES CANAL BUILDING

Canals and canal building have a long history in the United States. As early as 1673, Jesuit Father Pere Marquette and his voyageur compatriot Louis Joliet recognized the facility of a canal linking "the lake of the Illinois (Lake Michigan) into the St. Louis River (the Illinois) which empties into the Mississippi."[2] The earliest canal in the United States was completed when a 7 mile ditch bypassing falls on the James River was completed in 1784.[3] Another early project was completed in South Carolina in 1793. Despite these early successes, canal building in the United States did not begin in earnest until the latter part of the nineteenth century.

American canal systems can be characterized as one of two types.[4] The first can be characterized as developmental. Developmental canals were built to encourage and develop settlement and trade in a specific area. Typically, developmental canals were financed by the federal government. The second type of canal system was exploitive. Exploitive canals were built in order to realize a profit from transportation fees and tolls, and were usually funded by private investors.

The growth of canals in the United States occurred in three cycles between 1815 and 1860. The first phase took place between 1815 and 1834, when some 2,188 miles of canal were built. The second phase occurred between 1834 and 1844, when 1,172 additional miles of canal were built. The third cycle dates between 1844 and 1860, during which an additional 894 miles of canal were

constructed.[5] The canal building cycles are associated with discrete periods of intensive canal construction followed by intervening building.[6] Each phase is marked by the shifts in geographic distribution of canals as activity slowly began to spread west. The first cycle of canal construction was primarily concentrated in the eastern United States; the second stage focused on Illinois and Indiana, and the final stage was concentrated along waterways located further west.[7]

The first canal construction stage is epitomized by the construction of the 363 mile long Erie Canal, which was begun in 1817 and completed in 1825. Linking the Hudson River and Lake Erie, the Erie Canal was a developmental canal conceived as a vital link between the eastern seaboard and the Great Lakes region. Upon its completion, the canal was viewed as a great boost to plans for developing the interior regions of the United States.[8] The canal was an unprecedented financial success, collecting a 2.25 million dollar surplus in its first 8 years of operation.[9]

The success of the Erie Canal prompted an increase in canal construction throughout the first stage of the United States canal building cycle. Projects were undertaken in Pennsylvania, New Jersey, New York, and Ohio. However, none of these projects produced the Erie Canal's level of financial return.

The second cycle of canal construction began in the 1830s with a focus on the development of canals in the Old Northwest Territories. Second cycle canal projects were largely concentrated in Illinois and Indiana.[10] In Illinois, the Illinois & Michigan canal envisioned by Marquette and Joliet was begun, and construction commenced on a canal system linking Fort Wayne, Indiana and the Ohio River. Canal construction efforts during the second cycle of canal construction were severely hampered by financial difficulty brought on by the Panic of 1837.[11] The ensuing financial crisis resulted in the loss of foreign investment in canal projects, bank failures and the bankruptcy of canal companies.

The third cycle of canal construction is characterized by completion of many of the projects which had stalled during the previous cycle.[12] These projects included the Illinois & Michigan Canal in 1848, and the Indiana canal by 1849. Construction of the Indiana canal had bankrupted the state of Indiana, which was unable to properly maintain the facilities. The canal fell into disrepair and was not the financial success that had been envisioned. The Illinois & Michigan Canal, in contrast to the Indiana canal, was a financial success that is credited with a main role in the development of Chicago as a major shipping center.[13]

By the time that the third cycle of canal construction ended in the 1860s, there were over 4,000 miles of canals throughout the United States.[14] By this time, however, the canal building era in the United States was coming to a close. Many factors contributed to the decline in canal construction in the United States. For example, as the Industrial Age progressed in the United States, industries began to locate their operations away from rivers and canals, making water transportation a less effective method of moving freight.[15]

However, the major factor which contributed to the decline of the canal era in the United States was the development of the railroad as an alternate mode of freight transportation. Railroads were not only quicker than water transportation, but were also cheaper, and offered greater protection of goods. By the end of the 1860s, railroads were generally able to under-bid canal transportation, and had even managed to buy canal routes in many states.[16]

WISCONSIN CANAL BUILDING/FOX RIVER WATERWAY

The Fox and Wisconsin Rivers have played significant roles in the history of the region which was to become the State of Wisconsin. The two rivers, with the exception of the several hundred yards

which separate them in Portage, Wisconsin, provide a continuous water-route from the Great Lakes to the Mississippi River. This route, important to the prehistoric and historic Indian populations of the region, was traveled by Marquette and Jolliet in 1673 as they sought a route to the west coast of the continent.[17] Subsequently, the Fox and Wisconsin Rivers became a major route by which commerce of the fur trade was conducted. The importance of the Fox-Wisconsin Waterway was recognized by the United States government in 1873 as follows:

> There is no public work more national in character than this. By it the products of the northwest will find cheap transportation to the sea-board, and the lumber and iron of the north to the Mississippi Valley. One great problem of the day is to secure cheap transportation for these indispensable and bulky commodities; and while no one route will meet the demands of the country, there is no other route which will meet the necessities of so large a section of the United States at so small an expense as this.[18]

Conceived of as a slackwater developmental navigation system, the Fox-Wisconsin Waterway was designed to utilize dams and canals to bypass areas of river where natural hazards could not be improved. This extensive undertaking eventually resulted in the most extensive canal building project in Wisconsin history. On the Lower Fox River, these obstacles were considerable. Between Lake Winnebago and Green Bay, the Lower Fox dropped 168.3 feet in 37 miles and contained several rapids, which made river transportation extremely difficult.[19]

Initially, plans to improve the Fox-Wisconsin route for river transportation had been proposed in the early part of the nineteenth century.[20] The first attempt to improve the Fox-Wisconsin Waterway occurred in 1829, when the Michigan Territorial Legislature incorporated a company to dig a canal joining the Fox and Wisconsin Rivers at Portage, and to build roads around the rapids on the Fox River.[21] However, the project was never begun, and no improvements of the Fox-Wisconsin were attempted for five years.

In 1834, another effort at excavating the Portage canal was undertaken by the Portage Canal Company. Some progress was made, but the canal was not completed to satisfaction.[22] At the same time as the Portage canal was being dug, a group of Green Bay merchants began an effort to build a lock and dam at De Pere in order to bypass the rapids there. Although a dam and lock was completed at De Pere, the structures "constituted an obstruction to navigation for some time."[23] Additional efforts were made to complete the Portage canal in 1837 and 1838, but these too proved ineffectual.

In 1838, Wisconsin Territorial Governor Henry Dodge asked Congress to approve a plan allowing for the sale of 150,000 acres of land which would be used to fund the improvements of the Fox and Wisconsin Rivers.[24] Congress responded favorably to the request, noting the military importance of a canal facilitating troop movement from the Great Lakes to the western frontier.

Shortly following the congressional authorization of the land sale, two surveys of the Fox-Wisconsin Waterway were conducted by the federal government. The surveyors noted that the improved waterway would be economically and militarily important for the entire country, particularly those areas west of the Mississippi River. The Fox-Wisconsin Waterway would enable interior states to ship and receive goods using the Upper Mississippi River and the Great Lakes in the event that the Gulf of Mexico was ever blockaded.[25] The cost of the Fox-Wisconsin improvement was estimated at $488,470.18.[26]

Following the federal surveys, a number of plans were proposed by leading Wisconsinites for supplemental funding of the Fox-Wisconsin improvements. The first of these plans was proposed by James Doty, who as Territorial delegate in 1839, petitioned Congress to support a system of

internal improvement for Wisconsin which would utilize public, rather than private funds, and to improve the Fox-Wisconsin route.[27] Under Doty's plan, the Territory of Wisconsin would prosecute the improvements to the waterway, thereby retaining rights to the collection of any tolls.

The Doty bills were introduced in the House and Senate in 1839. Under the House bill, prosecution of the Fox-Wisconsin improvements would be carried out by a Territorial Board of Public Works, comprised of three citizens elected by the legislature. The board would possess the power to sell the lands granted by Congress, make loans, and fix tolls along the waterway. Despite a favorable reception, the House defeated the bill, and the Senate version was tabled.[28]

Another attempt to secure public funding for the Fox-Wisconsin improvements was begun in 1843 by New York Senator Nathaniel Tallmadge. With the assistance of Doty, Tallmadge became an investor in Wisconsin lands in 1843. Shortly after acquiring his holdings in Wisconsin, Tallmadge wrote Doty requesting Doty formulate a petition seeking improvements for the Fox River, and to draft a bill setting a $2.50 per acre price on granted lands. The proceeds of the land sales were to be applied to the Fox-Wisconsin improvements by the War Department, the proposed prosecutor of the work.[29]

In 1844, Tallmadge introduced a bill in the United States Senate that established land grants two sections in width on both sides of the Fox River. The lands closest to the river were to be sold at $2.50 per acre, while the second tier lands would be sold for $1.25 per acre.[30] The land sales would generate $600,000 to be applied to the cost of the Fox-Wisconsin improvements. The Tallmadge bill easily passed the Senate, but was never brought to a vote in the House. No future action was taken on the bill until 1845, when Morgan L. Martin was elected as Wisconsin Territorial delegate to Congress.

One of the leading advocates of the Fox River canal from its inception, Martin was the consummate speculator, having been involved in the promotion of the village of Milwaukee, as well as various banking and railroad ventures.[31] Shortly after he arrived in Green Bay in 1927, Martin was busy petitioning Congress for improvements to the Fox-Wisconsin route. Following his election as Territorial delegate, Martin was able to use his influence directly on members of Congress.[32]

In 1846, Martin successfully sponsored a bill in Congress which secured the federal land grant for the Fox-Wisconsin Waterway. Under the auspices of the bill, the state of Wisconsin, and not the federal government, was the prosecutor of the improvement. The state was to begin the project within 3 years and finish within 20, or the proceeds of the land grant sales would revert to the federal government.[33] The implementation of the Martin plan was contingent on its acceptance by the citizens of the state of Wisconsin. As a result, the plan became a major issue at the 1846 Wisconsin constitutional convention.[34]

At the constitutional convention of 1846, language was added to the state constitution which encouraged private sector finance of internal improvements within the state of Wisconsin. The state could only carry out improvements when land grants were offered by the federal government. Additionally, the constitution forbade the state from incurring a debt of over $100,000 for any internal improvements.[35] The 1846 constitution failed to receive the popular votes needed for its acceptance, thereby delaying state acceptance of the federal land grants.

A second constitutional convention was convened in 1848 and chaired by Morgan L. Martin. In the 1848 constitution, an amendment sponsored by Martin was adopted that allowed the state to finance improvement projects by appropriating anticipated project future revenues. Future revenue generated could then be used to aid project completion.[36] An additional resolution was added to the constitution that reduced the price of government land grant lands to $1.25 per acre.[37] The

constitution of 1848 was supported by the majority of voters in Wisconsin, and was accepted by the United States Congress on May 29, 1848. With the Congressional acceptance of its constitution, Wisconsin Territory was admitted to the union as a state.

Following the granting of statehood, Wisconsin moved ahead in its plans for the Fox-Wisconsin improvements. On August 8, 1848, the state legislature created a Board of Public Works which was authorized to award construction contracts and oversee sales of land grant lands.

The Board of Public Works operated for five years, commissioning surveys of the Fox-Wisconsin Waterway and selling land. Between 1849 and 1850, the board sold nearly 89,000 acres of land, and raised over $100,000. Sales soon declined, once most of the desirable land had been purchased. By 1852, barely a third of the 300,000 available acres had been sold, raising little more than $150,000.[38] In contrast, construction costs had soared to nearly twice this amount.

The cost overruns and lagging land sales renewed debate over whether the Fox-Wisconsin project should be completed using private money from investors. In 1851, Governor Dewey approved Morgan L. Martin's bid to construct the facilities at Kaukauna and Little Chute. Under the plan, the state issued Martin scrip bearing 12 percent interest, that was to be paid from land sale revenues. The scrip was backed by the State's pledges of the improvement itself, and future revenues of the improvement.[39]

In the fall of 1851, the Fox-Wisconsin project ran out of money necessary for continued improvements.[40] In addition to the monetary shortfall, a flood on the Wisconsin River had washed away nearly all of the Portage canal. The apparent squandering of state funds and shoddy workmanship of the improvement led to calls for an investigation of the project by a legislative committee. The investigation discovered no wrongdoing on the part of the Board of Public Works or contractors involved with the project.

At the same time of the legislative investigation, the newly elected governor, Leonard Farwell refused to sign the scrip submitted to the state by Morgan L. Martin. Farwell's refusal to sign the scrip touched off a conflict between the govemor and Martin that was eventually heard by the Wisconsin Supreme Court. The court ruled that the scrip did not constitute a state debt, and therefore could not be paid out of any fund other than the federal land grant fund.[41]

In 1853, another legislative investigation was launched to examine the progress of the Fox-Wisconsin Improvement Project and summarize its condition. The committee found that work on the Fox River facilities was progressing, but there was not enough land grant money to pay for the completion of the system. The committee recommended that the state consider selling the improvement to a private company that would pay for the remaining construction with the revenues of the improvement.[42]

In July of 1853, the state legislature passed a bill that incorporated the Fox and Wisconsin Improvement Company to complete the Fox-Wisconsin project. Under the terms of the bill, all rights formerly held by the state were transferred to the company if certain conditions were met. These conditions included provisions that: (1) limited the amount of tolls which could be collected; (2) required each officer of the company to file a $25,000 bond with the state; (3) required the completion of the project within three years; (4) passed all debts incurred by the state during the course of the improvements to the company; and (5) reserved for the state the right to purchase the system after 20 years.[43]

The Fox and Wisconsin Improvement Company began working on the completion of the waterway in the fall of 1853. Crews worked through the winter, and by the close of the 1854 construction

season, optimism ran high that the entire system would be operational by 1855.[44] This optimism was short lived, however, as the waterway was not opened until 1856. On June 16, 1856, the steamship Aquila arrived in Green Bay, becoming the first vessel to make the trip from the Mississippi to Green Bay via the Fox-Wisconsin Waterway.

With the successful passage of the Aquila from the Prairie du Chien on the Mississippi River to Green Bay, it appeared that the Fox-Wisconsin Waterway was finally completed. However, this was not the case. Because of seasonal fluctuations in the water level of the Fox River, the system was viable for vessels drawing more than 2 to 3 feet only during periods of high water. In order to make the system economically successful, the depth of the waterway would have to be increased. Soon after the completion of the passage of the Aquila, the Fox and Wisconsin Improvement Company began making plans to increase the depth of the waterway to accommodate vessels drawing up to 4 feet.[45]

In 1866, the burden of running the Fox-Wisconsin Waterway became too great for the Fox and Wisconsin Improvement Company, and the company filed for bankruptcy. Later in that year, the assets of the company were purchased and the company was reorganized as the Green Bay and Mississippi Canal Company.[46] The Green Bay and Mississippi Canal Company was not particularly interested in maintaining the waterway for navigation purposes. Instead, the company wished to develop waterpower along the river and turn the navigation concems over to the federal government.[47]

In 1870, the United States Congress passed legislation which allowed the federal government to purchase the Fox-Wisconsin Waterway. A price for the facilities was set by an arbitrator who, after deducting the value of waterpower, income generated by the land grant, and personal property, determined the value of the waterway to be $145,000.[48] The transfer of the Fox-Wisconsin Waterway to the United States was completed on October 28, 1872.[49]

Following the purchase of the lock and dam system of the Fox-Wisconsin Waterway by the federal government in 1872, an assessment survey was conducted by government surveyors. In a report submitted following the survey, a five point plan was proposed for revitalizing the waterway. First, the plan called for all facilities on the Lower Fox River to be repaired in order to keep the system navigable. Second, new lock and dam facilities would be constructed on the Upper Fox where necessary to maintain navigability. Third, all of the canals on the Fox River were to be dredged as needed. The fourth point of the plan called for improving the Wisconsin River by constricting its channel.[50] The fifth, and long term, goal of the plan was to replace all locks and dams on the Fox River with structures constructed of stone masonry or of timber cribs filled with stone.

Throughout the late 1800s and early 1900s, the federal govemment replaced the deteriorating lock facilities on the Lower Fox with permanent stone constructions. Similarly, between 1924 and 1941, the government launched a plan to replace the Fox River dams with concrete structures. Additional infrastructure alterations were made throughout the 1930s.

By the end of the 1930s, shipping on the Fox River reached a level of 325,000 tons per year.[51] The figure never grew appreciably beyond this mark. By the mid 1950s, the Fox River system was shipping less freight than railroads in the area. At the end of the decade, the last commercial barge locked through the system. Since that time, the system has been used exclusively by recreational traffic.[52] The United States Army Corps of Engineers continues to maintain the system in caretaker status.

NAVIGATIONAL STRUCTURES OF THE LOWER FOX RIVER WATERWAY

The Lower Fox River Waterway is comprised of eight individual complexes: the Menasha Lock and Dam Complex; the Appleton Locks and Dams Complex; the Cedars Lock and Dam Complex; the Little Chute Locks and Dam Complex; the Kaukauna Locks and Dam Complex; the Rapide Croche Lock and Dam Complex; the Little Kaukauna Lock and Dam Complex, and the De Pere Lock and Dam Complex. In general, there are five major types of structures associated with each of these complexes. These structures include locks, dams, canals, lockkeeper's residences and lock shelters. Other miscellaneous structures include waste weirs, ancillary facilities such as a dry dock, and various utility buildings.

Locks

The locks of the Lower Fox River Waterway were built between 1850 and 1979 and are either of composite, quarried stone, or concrete construction. The earliest locks are of composite construction. The majority of locks in the Lower Fox River Waterway are of quarried stone construction which replaced the earlier composite locks. The most recent locks are of concrete construction which replaced some quarried stone locks.

All of the locks of the Lower Fox River Waterway were originally composite. However, Kaukauna Fifth Lock is the only remaining example of composite lock construction. Composite locks represent one of the earliest techniques used in canal construction in this country. Uncut stone fill provides the structural basis for this type of lock.[53] In composite construction, dry rubble stones are covered with wooden planks in order to form a watertight lining for the lock chamber. The planks also provide protection for vessels during locking.

Each of the locks' four gates (two upper and two lower) is constructed of squared pine timbers laid in horizontal courses and held together with vertical oak beams. The upper lock gates are opened and closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, butterfly valves in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock gates.

Quarried stone locks are most common in the Lower Fox River Waterway. These locks were built to replace composite locks and are characterized by lock chambers constructed of quarried stone block. The sides of these chambers are capped with quarried stone coping or in some instances concrete.[54] The gates, valve arrangement and operating mechanism on this type of lock is identical to those at the composite locks. Appleton 1, 2, 3, and 4, Cedars, Little Chute 2, 3 and 4 (the combined locks), and Kaukauna 1, 2, 3, and 4 are quarried stone locks.

The remaining locks of the Lower Fox River Waterway are constructed of concrete and are similar in type to those pioneered at the Hennepin Canal in Illinois.[55] With the exception of the gates, the entire facility is constructed of reinforced concrete. The concrete locks have four, one piece, steel gates. The operating mechnism is similar to that of the quarried stone locks. The four concrete locks of the Lower Fox River Waterway are found at Rapide Croche, Little Kaukauna, De Pere and Menasha.

The locks of the Lower Fox River Waterway are part of a hand-operated system unique to the State of Wisconsin and rare in the United States. The system illustrates the evolution of lock design and

construction technology from the early composite locks, through quarried stone examples, to the most recent constructions that utilize poured concrete. The Lower Fox River locks are part of a unique 100 year old system that remains intact and potentially functional.

Dams

The United States Government dams built on the Lower Fox River Waterway were constructed for the most part between 1927 and 1940, although the dam at Menasha underwent major reconstruction in 1956 and again in 1985. These dams are placed in the main channel of the Fox River and are either anchored to the stone bottom of the river or to piles driven into the bottom of the river. The dams are constructed of concrete with an average length of 500 to 600 feet, although actual length varies from a minimum of 400 feet to a maximum of 961 feet. In general the dams are built adjacent to a lock or adjacent to a canal which contains more than one lock. All of the dams have at least two sections, a spillway that fixes the height of the dam and over which the water flows, and the sluiceway which contains the gates of the dam. Most dams (De Pere, Little Kaukauna, Rapide Croche, Kaukauna, Little Chute, and Cedars) have two spillway sections, one on each side of the sluiceway.

The sluiceway portion of the dam contains steel taintor gates which can be raised or lowered to adjust the flow of water. The sluiceway gates are operated by a "crab", a mechanism containing a pair of electric winches that moves from gate to gate along a track on top of the sluiceway. The crab is constructed of two lengths of channel iron connected parallel to each other by four sections of I beam iron. The crab winches are powered by a five horsepower electric motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch gauge track mounted along the downstream length of the sluiceway.

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate. Once positioned, the crab is connected to a power source, and the winches are turned on until the gate has been raised to the desired height. Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened. When not in use, the crab mechanism is housed in a wooden structure built over the span between the two easternmost sluiceway piers. A set of double doors on the sluiceway side of the crab house allow the crab to be moved along its track and positioned at the gates. The upstream and downstream sides of the crab house each contain a single window located in the center of the wall. The crab house is covered with a moderately pitched, front-gabled asphalt shingle roof.

The dams are part of the Lower Fox River Waterway and are responsible for creating the slackwater pools on which boats navigated between locks. Additionally the dams on the Lower Fox River flooded the canals that harbor the locks. Without the dams, the locks, and the navigable waterway in which the locks are located, would not exist.

Canals

There are a little more than 5 1/2 miles of canals located within the Lower Fox River Waterway. For the most part, canals are excavated ditches, the banks of which have been stabilized by means of riprapping in certain locations. Canal depths rarely exceed 6 feet; canal width ranges between 100 and 125 feet. The canals have all been dredged periodically.

Lockkeeper's residences

Ten of the original 12 lockkeeper's residences are present within the Lower Fox River Waterway. These houses were constructed very close to the locks themselves and housed the lockkeeper and his family. Eight of the 10 are no longer occupied; the residences at the Combined Locks (Little Chute 3 and 4) and Menasha are rented to private individuals.

There are three types of lockkeeper's residences associated with the Lower Fox River Waterway: a gabled ell, side gable, and Colonial Revival. Gabled ell houses are found at Appleton 1, Appleton 3 and Kaukauna 1. Gabled ell houses are identified by their "L" or "T' plan, two gabled wings, a front porch with either a hipped roof or a shed roof, and a front door located where the gabled wings meet.[56] A side gabled house is present at Menasha. Side gabled houses have rectangular plans with the main entrance in the wall parallel to the street. Side gabled houses frequently have a full or partial front porch.[57]

A Colonial Revival house is present at the Rapide Croche Lock and Dam Complex. Colonial Revival houses are characterized by their symmetrical design, gabled roof and dormers, and a classically derived entrance.[58]

A variation on the Colonial Revival is the Dutch Colonial Revival. This type of lockkeeper's residence is the most common to the Lower Fox River Waterway; examples are found at Cedars, Little Chute 2, Combined Locks, Little Kaukauna, and De Pere. All of these residences were built from the same plans between 1910 and 1930. Similar to the Colonial Revival, the Dutch Colonial Revival also incorporates a gambrel roof and contrasting building materials such as brick walls and shingled gables.[59]

The lockkeeper's residences were central to the operation of the Lower Fox River Waterway. The structures served as year round on-site residences for the lockkeeper and his family.

Lock Shelters

Small structures that serve as an office for on-duty lockkeepers are located at each of the locks except for the guard locks at Little Chute and Kaukauna. The lock shelters are located immediately adjacent to each lock. Single story, front gabled sheds constructed between 1917 and 1940 are present at Appleton 2 and 3, Cedars, Little Chute 2, Combined Locks, Kaukauna 1, 2, 3, 4, and 5, Rapide Croche and De Pere. The remaining lock shelters are modern metal sheds constructed in the late 1970s and early 1980s.

These structures provided shelter, office space and storage for on-duty lockkeepers. The lock shelters are currently serving the same purpose for which they were built and are central to the operation of the Lower Fox River Waterway.

LOCK AND DAM COMPLEXES OF THE LOWER FOX RIVER WATERWAY

From 1872 through 1884, the United States Army Corps of Engineers completed the efforts of several private companies to construct a navigable waterway between Little Lake Butte des Morts and De Pere. Save for minor alterations, the Lower Fox River Waterway has changed little since its initial completion. The hand-operated system is the only one of its kind in Wisconsin and one of very few remaining examples in the country. There are eight lock and dam complexes associated with the Lower Fox River Waterway: Menasha, Appleton, Cedars, Little Chute, Kaukauna, Rapide Croche, Little Kaukauna, and De Pere.

Menasha

The Menasha Lock and Dam facility was constructed as part of the Fox-Wisconsin Improvement Project to allow safe passage through the Winnebago Rapids located between Doty Island and the town of Menasha. In September of 1848, Condy R. Alton was chosen as the Fox-Wisconsin Improvement Project's chief engineer responsible for surveying and assessing the existing facilities located along the Fox River. After surveying the facilities at Menasha, Alton reported to the Board that navigation through the Winnebago Rapids could be accomplished with the construction of a lock and canal facility.[60] The contract for the construction of the lock and dam facilities at Menasha was awarded to Curtis Reed, who paid the state $5,000 for the contract.[61] In 1849, Alton reported that the facilities near Menasha at the Winnebago Rapids were under construction.[62] By 1850, a crib dam had been constructed and two-thirds of the canal had been excavated.[63]

In 1866, Major Charles Sutter was assigned the task of surveying all of the proposed route from Green Bay to the Mississippi River.[64] During the survey, Sutter found two sets of navigation facilities associated with the Winnebago Rapids, one on the north channel near Menasha, and one on the south channel near Neenah.[65] The Menasha facility included a canal, a lock, and a dam which were all operational at the time of the survey. Conversely, the facility at Neenah was no longer operational. Sutter also reported that the Menasha dam was actively employed for commercial use and would require the least amount of effort to improve.[66]

In 1872, the federal government purchased the Fox and Wisconsin Improvement Project from the Mississippi and Green Bay Canal Company. The government appointed Major D.C. Houston to manage the lock and dam system in 1873.[67] One of Houston's first duties was to conduct yet another survey along the Fox-Wisconsin Waterway. Following the survey, Houston noted that a number of repairs had been conducted on the Menasha lock since 1866. He also noted that the canal had been deepened and widened.[68]

Beginning in the 1870s and continuing through the mid 1900s, the Menasha Lock and Dam facilities have undergone a number of repairs and alterations due to general maintenance. For example, in 1875 the lock chamber was entirely drained in order to repair a leak in the lock floor.[69] Nine years later, the lock was again temporarily closed to conduct major repairs in several areas. At that time both mitre sills, the lock chamber walls, and the upper and lower gate walls were reinforced. Additional repairs included the stripping and replanking of portions of the floors and side walls, as well as the replacement of the gates, hollow quoins, and foundation material.[70] In 1887, repairs were made to the lower wing walls, and in 1889 the lock chamber was replanked, and new gates and mitre sills were installed.[71]

In 1934 and 1935, the U.S. Army Corps of Engineers reported the old timber dam at Menasha to be in an advanced state of decay, and as having inadequate flood discharge capacity for the regulation of Lake Winnebago water levels.[72] Consequently, the Corps of Engineers recommended that the dam be rebuilt as soon as the necessary funds were available.[73] Funds for the reconstruction of the Menasha dam were allocated in 1936, and the new dam was in place by the end of the 1937 construction season.[74]

Repair work continued on the Menasha Lock and Dam facility throughout the 1940s and 1950s. Two new taintor gates were installed on the dam sluiceway in 1941, and repairs to the lock chamber walls and gates were carried out.[75] With commercial traffic beginning to wane on the Fox River by the beginning of the 1950s, the pace of construction and major repairs slowed at the Menasha Lock and Dam facility. The major repair project during this period was the replacement of the masonry sluice piers of the dam with piers constructed of poured concrete.[76] At the time that the sluiceway piers were replaced, the six Menasha dam taintor gates were also replaced.[77]

Other repairs during the 1950s included the lining of the lock floor with asphalt, and the installation of a safety rail around the lock chamber.[78]

The last commercial vessel locked through the Lower Fox River in 1959.[79] Following the demise of commercial traffic on the Fox River, the locks of the Lower Fox River have been primarily used for recreational purposes.[80]

Because of its location between Little Lake Butte des Morts and Lake Winnebago, the Menasha Lock receives heavy traffic from recreational boats traveling between the two lakes. Partly due to the recreational importance of the Menasha lock, the Corps of Engineers recommended that the lock be rebuilt.[81] Design work began on the proposed lock in 1978, with rehabilitation of the existing structure beginning that year as well.[82] Final work was completed on the Menasha lock in 1979, at a reported cost of $1,225,038.[83]

On July 24, 1984, design plans for the reconstruction of the Menasha dam spillway and repairs of two sluice piers were approved by the Army Corps of Engineers Office in Detroit. The submitted plans were slightly modified during construction. Reconstruction of the Menasha dam was completed in 1985. The "as built" design plans were submitted to the Fox River Project Office in Kaukauna on September 17, 1985.[84]

The 1985 rebuilding of the spillway and associated repairs to the sluice piers were the last major construction project to take place at the Menasha Lock and Dam facilities. Today, the Menasha lock is one of the busier facilities on the Fox River due to its location between Lake Winnebago and Little Lake Buttes des Morts.[85] It is estimated that on a summer weekend, the lock provides passage to 200 to 300 water craft.[86]

Appleton

Included in a 1848 report to the Board of Public Works of the newly formed State of Wisconsin were Condy R. Alton's recommendations for improvements of the locks and dams at Appleton, then known as Grand Chute. The rapids at Appleton extended 1.5 miles and fell 4 feet in elevation, representing one of the greater navigational challenges along the Lower Fox River. To avoid these hazards, Alton suggested the construction of a canal in excess of 9,600 feet in length to bypass the rapids. He also suggested that a 660 foot long dam with a 6 1/2' head be built above the rapids to flood the canal. Alton recommended 4 locks be placed within the canal, including 2 with a 10 foot lift, one with a 9 foot lift, and one with an 8 foot lift.

In November 1849, the Board of Public Works met to consider proposals for work at Grand Chute (Appleton).[87] However, proposed costs for the Grand Chute facilities exceeded the amount the Board wanted to pay at the time. Consequently, no action was undertaken for the construction of the locks and dams at Appleton until the following year.

The Board of Public Works accepted bids for the facilities at Grand Chute in 1850. The Board accepted Fitch P. Talmadge's proposal to build the Grand Chute canal and locks for $56,747. In 1851, Alton reported to the Board that about 20 chains of canal had been excavated at Grand Chute, along with the upper lock chamber. Although work continued on the facilities at Grand Chute in August 1852, they were interrupted by mounting financial difficulties and a tense political atmosphere at the state capitol.[88] By October 1853, work had resumed at Grand Chute. By 1859, the lower dam, fourth lock, and canal were completed.

In 1866, control of the Fox River waterway was transferred from the bankrupt Fox and Wisconsin Improvement Company to the Green Bay and Mississippi Canal Company. The federal

government continued its interest in the canal system during this period, sending Major Charles Sutter to survey the Lower Fox and offer recommendations for improvement. At Grand Chute, Sutter found two dams and four sets of locks. The lower dam was noted as being 440 feet long and watertight, therefore not requiring extensive improvements or repairs. The upper dam at Grand Chute was 800 feet long and 7 feet high. It had experienced some seepage, and approximately 430 feet of the dam had settled. Locks 1, 2 and 3 were positioned in a 3,600 foot canal which bypassed the upper dam. Each of these locks required some new planking and new gates. The fourth lock at Grand Chute, situated in a 1,267 foot canal bypassing the lower dam, was in good condition, although a new gate was recommended.

By 1870, the Green Bay and Mississippi Canal Company successfully interested the United States Government in taking over the waterway and all aspects of achieving and maintaining navigation on it. Major D.C. Houston was placed in charge of the waterway in 1872 and his initial responsibility was to inspect the various facilities and recommend needed improvements.[89] In his report to Congress, Houston described the facilities at Appleton as not being in good condition.[90] The Upper Dam required graveling each season to keep it tight, Locks 1, 3, and 4 needed replanking below the water line, and Lock 2 was in need of major rennovation since its south wall was being undermined and was liable to collapse.[91]

In response to Houston's report, a five point plan was developed and later implemented to revitalize the Fox-Wisconsin Waterway. The government immediately began replacing the weakest facilities on the Lower Fox River. Between 1880 and 1890 the first and second locks at Appleton had been rebuilt, and the third lock was rebuilt in the 1890s.[92]

When the government acquired the Fox River Lock and Dam system in 1872, it began a program of rebuilding crib and brush dams with those constructed from stone. However, by the late 1920s, even these dams were unable to the meet the demands of the system. In 1933, the Corps of Engineers reported that the "lower timber crib dam at Appleton is badly decayed and has inadequate flood discharge capacity. The dam should be rebuilt as soon as funds are available."[93] Removal of the lower Appleton timber crib dam and construction of a new concrete dam was completed in 1934.[94] In 1937, the upper dam at Appleton was reported to be "in poor condition and having insufficient flood-discharge capacity for the proper regulation of Lake Winnebago."[95] This upper Appleton dam was removed and rebuilt in concrete in 1941.[96]

Cedars

In his 1848 assessment of the Cedar's rapids, Condy R. Alton recommended, the construction of a dam, lock, and canal.[97] Coincident with construction of other facilities along the Fox-Wisconsin Waterway, construction of the original dam and timber lock structure at the Cedars Rapids was begun in 1850.[98] The original construction included a 700 foot dam with a 6 foot head, a single 140' long lock with a 10 foot drop, and approximately 660 feet of canal. As construction progressed in 1851, the commissioners of the Board of Public Works decided that all new locks should be 160 feet long and 35 feet wide in order to accommodate larger vessels.[99] The construction company of White, Resly, and Arndt, who were charged with constructing the Cedars facility, began building the lock to these required dimensions.[100] The first locks were designed to be constructed of timber, but were actually built as a composite timber and stone lock.[101] By late 1851, construction of the Cedars dam and canal was completed and the completion of the lock was projected for the summer of 1852.[102] By 1853, the locks were still not completed, and a legislative committee began an investigation into the slow pace of construction.[103] The committee found the delays due in part to fiscal limitations placed on the project and the conflict which had developed between Morgan L. Martin and Governor Leonard Farwell in 1852-1853. An ardent supporter of the Fox-Wisconsin system since its inception, Martin played a key role in securing

federal funding for the project when he was Wisconsin's territorial delegate to Congress from 1845 to 1847.[104] In 1851, the State Legislature contracted with Martin to construct the facilities at Kaukauna and Little Chute.[105] At the heart of the dispute between Martin and Farwell were issues relating to payment due Martin for construction at these facilities. However, the Cedars facility was operational by 1856, when the Aquila became the first steamer to successfully navigate the Fox-Wisconsin Waterway.[106]

Maintaining, operating, and improving the Cedars facility was a constant problem. An 1866 survey of the Cedar's facility found that the 740 foot long dam had settled from 1 to 18 inches over the entire length of the dam. Additionally, the condition of the lock had deteriorated, requiring gate repairs and replacement of decayed timbers.[107]

Construction of the original composite lock at the Cedar's facility began in 1850.[108] This lock was built of stone and timber, was 160 feet in length, and 35 feet wide, and had a 10 foot drop.[109] Ten years after the completion of the Cedars lock, an 1872 survey found the lock gates in need of repair. The survey also suggested replacement of some lock chamber timbers.[110] Between 1872 and 1875, rock was dredged from the lock chamber, the lock was replanked where needed, and gate repairs were completed.[111] In 1878, the two upper lock gates were replaced.[112] Additional repairs were conducted on the lock walls and a new capstan platform was constructed in 1879.[113] By 1880, lock wall planking had been replaced and a new timber gate was installed. In addition, two new hollow quoins were installed on the lower gate and new coping was installed on the south wall and along 75 feet of the north wall.[114]

In 1880, due to the deteriorating condition of several of the lock and dam facilities on the Fox River, the U.S. government initiated an extensive rebuilding project on the Lower Fox that continued through 1890.[115] In 1887, the original Cedars lock was removed and construction of the present lock was completed in 1888.[116] The new lock chamber and walls were constructed of limestone blocks. New lower gates were built for the lock at the time of its completion, while the 1879 upper gates were rehabilitated. All four gates are constructed of squared wood timbers. In 1941, the 1887 gates were replaced with new 20 foot pine timber mitre gates.[117]

By 1932, a conditions report noted that the original dam was decaying rapidly. It was also noted at this time that in its present state of disrepair, the old dam could no longer adequately discharge flood waters.[118] Consequently, construction of a new concrete dam with an overall length of 654 feet was begun in 1933 and completed in 1934.[119] No structural modifications are known to have been made to the dam since its completion.[120]

The 1852 canal has been periodically dredged throughout its existence in order to maintain a navigable depth. The present Cedars canal is aligned east to west and is approximately 1,350 feet long. Canal width varies between 40 feet at the lock to 150 feet at the eastern end. A cut stone retaining wall lines most of the canal bank.

The original lockkeeper's residence at the Cedars Lock and Dam facility was constructed in 1893. Between 1901 and 1909, this structure underwent numerous structural repairs.[121] By 1927 a decision was made to replace the old lockkeeper's residence with a new dwelling at a total cost of $8, 811.25.[122] This new structure is a Dutch Colonial Revival style house commonly used for lockkeeper's residences at Fox River Lock and Dam facilities. Additional standing structures at the Cedar's facility include a lock shelter (circa 1917), a modern garage, and a modern metal shed.

Little Chute

Condy R. Alton noted "formidable rapids" at Little Chute and proposed construction of a 500 foot long, 6 foot high dam, an 8,316 foot long canal, and four locks. Alton estimated improvement costs at $70,929.[123]

Despite an ongoing funding debate, the Board of Public Works contracted with Morgan Martin to construct the facilities at Little Chute in 1852.[124] According to the contract, the locks were to be built of stone and timber and would measure 160 feet in length, 5 feet in depth and 35 feet in width. Construction of the facilities at Little Chute was completed in 1856.[125]

In 1866, Major Charles Sutter was appointed to survey the entire system and make recommendations for maintenance and improvement. At Little Chute, Sutter noted that all four locks were in need of maintenance and that Lock 2 needed two new gates.[126] Although the facilities owners, the Green Bay and Mississippi Canal Company, acted on some of Sutter's recommendations regarding other complexes in the Fox River system, no improvement work was undertaken at the Little Chute Lock and Dam.

Following the purchase of the Fox River Lock and Dam system by the federal government in 1872, another assessment survey was conducted by government surveyors. During the course of that survey, it was determined that the combined locks at Little Chute were in poor condition and should be completely replaced. It was also noted that the Little Chute dam could not hold another foot of head. Consequently, if additional head was required, a new stone dam should be built.[127]

Subsequent to the 1872 survey, the United States Army Corps of Engineers embarked on a program designed to improve navigation on the Fox-Wisconsin Waterway.[128] The plan called for all the facilities on the Lower Fox to be repaired, followed by rebuilding of locks and dams on the Upper Fox. In addition all canals were to be dredged as needed. By 1880 the combined (downstream) locks at Little Chute had been rebuilt using quarried stone.[129] Between 1880 and 1890 Little Chute Lock 1 (now the guard lock) was also rebuilt.[130] Finally, in 1933, the stone dam at Little Chute was replaced with a concrete facility. Since the completion of the concrete dam, there have been no major alterations to the Little Chute Complex.

Kaukauna

Following an 1848 survey, engineer Condy R. Alton noted 1 1/2 miles of rapids at Kaukauna, where he recommended the construction of a 1.5 mile long canal containing five locks, two with a 10 foot lift, two with a 9 foot lift, and one with an 11 foot lift. In addition, Alton recommended construction of a 660 foot long, 6 foot high dam.[131]

Nothing was done about Alton's recommendations for making the Fox River more easily navigable at Kaukauna until 1851, when the Board of Public Works contracted with Morgan Martin to build the required facilities at Kaukauna.[132] Plans called for the locks to be built of stone and timber; dimensions were specified as 160 feet long and 5 feet deep in order to handle the larger ships which were being constructed at the time.[133] The contract called for the construction to be completed within two years of May 1851.[134] However, by April of 1853, the Kaukauna Complex was still incomplete. As a result, the State of Wisconsin instituted an investigation into the construction status of the dams and locks on the Fox River. The investigation committee was formed in April, began inspection of the facilities in May, and completed a report in June of 1853.[135] In the report, the investigators noted that construction was not complete at Kaukauna, and it would cost about $65,000 to finish.[136]

By this time, the State of Wisconsin funds for the construction of the canal system along the Fox River were exhausted. Accordingly, a private venture named the Fox River Improvement

Company was formed in order to complete the construction.[137] In October of that year, the new company received a land grant, and work was resumed at Kaukauna.[138] By May of 1854, the Kaukauna facilities were operational and steamships were making daily trips from Green Bay to Kaukauna.[139]

Major Charles Sutter was responsible for another survey intended to identify the major trouble spots along the waterway. From September 30 to October 16, 1866, Sutter surveyed the Lower Fox River, including Kaukauna. At Kaukauna, Major Sutter found a 7400 foot canal with two passing basins which contained a total of five locks. Sutter reported the Kaukauna dam to be 583 feet long and 6 feet high.[140]

The federal government assumed control of the locks and dams on the Wisconsin and Fox Rivers in 1872.[141] Subsequently, an additional survey was conducted resulting in a recommendation that the dam at Kaukauna be rebuilt of stone.[142] The survey report also stated that, although all five of the locks at Kaukauna had received some repairs since 1866, all needed additional work.[143]

In accordance with recommendations of the 1872 report, Kaukauna Locks 3 and 4 were reconstructed as permanent structures built of quarried stone blocks. This work was completed by 1880.[144] Kaukauna Lock 1 was similarly rebuilt in 1882.[145] Kaukauna Lock 2 was not rebuilt until 1903.[146] Kaukauna Lock 5 was never rebuilt, although the lock received substantial repairs throughout its working life. Finally, the dam at Kaukauna was rebuilt of concrete in 1932.[147] By 1932, the Kaukauna facilities were complete in their present configuration. The only changes made since include refurbishing and routine maintenance.

Rapide Croche

Condy R. Alton's 1848 report to the Board of Public Works of the State of Wisconsin noted slight rapids at Rapide Croche near Wrightstown and proposed the construction of a 650 foot long, 6 foot high dam. He also felt that one lock with a 6 foot lift situated within an 800 foot canal would be adequate to allow boat travel through the rapids. In his report, Alton recommended that the lock at Rapide Croche be among the first projects undertaken to make the Fox River more easily navigable.[148]

In May of 1849, a contract was awarded to Joseph Maynard for the building of the lock and dam at Rapide Croche.[149] By the close of the 1849 construction season, a brush and stone dam (no longer extant) was completed; the associated canal and lock remained under construction.[150] On June 14, 1850, the first vessel passed through the De Pere lock and navigated the Fox River to Rapide Croche, which was still under construction. By August, the Indiana, a steamship from Green Bay, was making daily trips through De Pere to Rapide Croche. The Milwaukee Sentinel reported that the Rapide Croche facilities would be operational by mid-September of 1850.[151] Construction was complicated by a cost overrun resulting from the discovery that the floor of the lock needed to be lowered because of intermittent low water levels. In spite of this setback, the lock and canal at Rapide Croche were completed in 1850.[152]

From 1850-51 the brush and stone dam at Rapide Croche washed out several times because the flat rock river bed was poorly suited to support a dam that was not securely anchored. In order to remedy this problem, construction of a new spar dam bolted to the rock of the river bed was begun in 1851.[153]

Due to financial difficulties involving the Fox-Wisconsin project, a legislative committee was formed in April of 1853, and began an investigation into the status of the locks and dams on the

Fox River.[154] Inspection of the facilities on the Fox-Wisconsin Waterway took place one month later in May, and a report was completed in June of the same year.[155] In the report, the investigators stated that although the Rapide Croche Lock and Dam were complete, the facilities were inadequate, and would require an additional $17,000 of modifications.[156]

In 1866, a survey of the Fox-Wisconsin system was conducted in order to identify the major trouble spots along the waterway. At Rapide Croche, the surveyors found a "fine stone lock" located within a 1,800 foot canal.[157] The Rapide Croche dam, the only stone dam on the Fox River, was found to be 440 feet long and 6 feet high.[158] As a result of the 1866 survey, it was determined that the depth of the Fox-Wisconsin Waterway needed to be increased in order to allow for the passage of vessels drawing up to 4 feet.[159]

Following the purchase of the Fox-Wisconsin Lock and Dam system by the federal government in 1872, Major D.C. Houston was assigned responsibility for operation of the waterway. One of Houston's first actions was to initiate an additional conditions survey. Results identified the lock at Rapide Croche as "a fine piece of work, being of cut-stone masonry."[160] The report also stated that the dam maintained an adequate water level, but needed additional reinforcement.[161]

In 1903, plans were prepared for a new lockkeeper's residence at Rapide Croche, with construction taking place in 1906.[162] The design included the lockkeeper's residence with a fence enclosing a 150 foot square area.[163] A lock shelter and a single story shed were constructed around 1917.[164]

In 1931, the Rapide Croche dam was rebuilt of poured concrete.[165] At the same time that the dam was rebuilt, plans were developed to replace the Rapide Croche lock with a new reinforced concrete construction over a 3 year period.[166] The reconstruction of the lock was completed in 1934, although the old lock was not yet removed.[167] With the completion of the new lock and dam, the Rapide Croche Lock and Dam facility attained its present form. In subsequent years, the lockkeeper's house was moved approximately 650 feet west of its original location and a barn located at the complex was demolished. A sanitary facility was added in the 1960s, and a garage was built circa 1975.[168]

Little Kaukauna

In 1856, the Aquila became the first steamer to successfully navigate the Fox and Wisconsin Waterway between the Mississippi River and Green Bay. However, the Aquila's successful journey was only possible during months of high water levels. A report prepared in 1856 for the Wisconsin State Assembly, noted that difficulties negotiating the rapids at Little Kaukauna consistently plagued navigation between Green Bay and Lake Winnebago on the Lower Fox River.[169] Consequently, in 1846, the Fox and Wisconsin Improvement Company developed a plan to increase the depth of the waterway and to construct a lock and dam at Little Kaukauna Rapids.[170] The lock and dam was completed between 1857 and 1866.[171]

In 1866, Major Charles Sutter reported that the Little Kaukauna lock was in good condition. Sutter also reported that the Little Kaukauna Complex included a 1,166 foot canal that bypassed a 550 foot long, 6 foot high dam. However, by 1869, the Little Kaukauna dam was leaking badly and was partially washed out.[172]

Following the 1872 federal purchase of the Fox River Lock and Dam system a new survey was conducted. Results indicated that the Little Kaukauna lock needed new plank lining; however, the partially washed out dam had been rebuilt and strengthened.[173] In 1873 Major Houston of the

U.S. Army Corps of Engineers stressed the importance of the Fox-Wisconsin Waterway system to the development of an inexpensive national transportation system. Consequently, Houston devised a five point plan to improve the Fox-Wisconsin Waterway system. As part of Houston's plan the pile and timber dam at Little Kaukauna was to be replaced by a 587.7 feet long concrete structure. The new dam was finished in 1927 at a cost of $48,299.83.[174]

The crib timbers above the low water line at the Little Kaukauna lock were replaced and the entire lock chamber was relined with double thickness planks in 1875. In addition to these repairs, the upper gates were replaced and the lower gates were replanked.[175] On November 20, 1886 the lock was again closed to navigation in order to undertake a series of extensive repairs. At this time "All the planks, two courses, were removed from the sides and floor; the coping timbers and posts above the lower girts were taken out and replaced by new. The gates and hollow quoins were removed, new hollow quoins were framed and placed, and the gates repaired and rehinged. The mitre sills were removed, dressed over, replaced and fastened..., 6,092 superficial feet of double planking were spiked down in the floor, and 6,099 superficial feet in the chamber walls."[176] Additional more minor repairs were conducted on the timber-lined lock in 1908, 1909, 1910, and again in 1917. The Little Kaukauna lock was completely rebuilt in 1939. Little Kaukauna was one of the first three locks to be rebuilt with reinforced concrete.[177] Construction on this lock continued for 4 years at a total cost of $362,426.81.[178] In 1940, the left wall of the original lock was lowered and three cribs were built above the lock on the right side of the canal.[179] The lock gates were cleaned and painted in 1947.[180] Along with improvements to the Little Kaukauna navigational facilities, a new lockkeeper's house similar to the one at Little Chute was constructed in 1911.[181]

De Pere

Construction of the first lock and dam facility at De Pere was begun in 1836. This dam was subsequently washed away by a storm in 1847.[182] In 1848, the Board of Public Works of the newly formed State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the existing dams on the Fox River and suggest navigational improvements to other areas of the river. Alton reported the existing wooden lock and dam was in disrepair and suggested the lock be replaced by one built of stone.[183] Construction of a composite lock at De Pere began in 1849, coincident with construction of other facilities along the Fox-Wisconsin Waterway. By the summer of 1850, construction of the De Pere lock was complete, with the first riverboat passing through the facilities on June 14, 1850.[184]

In 1866, the federal government surveyed the navigation facilities of the entire Fox-Wisconsin Waterway. During the survey, the De Pere Lock and Dam facilities were measured, and noted to consist of a 6 foot high, 1,400 foot long dam, bypassed by a 750 foot long canal containing a composite lock 140 feet in length and 35 feet in width. The length of the De Pere lock was noted to be some 20 feet shorter than the lengths of other locks on the Fox-Wisconsin Waterway.[185]

Following the purchase of the lock and dam system of the Fox-Wisconsin Waterway by the federal government in 1872, another assessment survey was conducted by government surveyors. During the course of the survey, it was found that the length of the De Pere locks had been increased some 23 feet since 1866. The dam at De Pere was listed as being in "decent shape."[186] Subsequent to the 1872 survey, the United States Army Corps of Engineers embarked on a program designed to keep the Fox-Wisconsin system open to navigation.[187] This program consisted of regular maintenance and construction at lock and dam facilities as well as dredging of navigation canals.[188] At De Pere, work began with the construction of a lockkeeper's house in 1879.[189]

Throughout the late 1880s and early 1900s, several repairs were made to the lock facilities at De Pere, including the replanking of the lock chamber as needed.[190] In 1887, the lock chamber was lowered by 2.5 feet and entirely replanked. Additionally, the lock's mitre sill was secured to the rock floor, and seams in the floor were filled with rock and mortar.[191] New timber lock gates and valves were installed in 1905, and wooden gate spars which had rotted were replaced in 1907.[192] Between 1912 and 1913, the original lockkeeper's residence at the De Pere Lock and Dam facility was replaced by a new dwelling, at a total cost of $ 3, 052.[193]

In 1927, in the Annual Report of the Chief of Engineers, the De Pere dam was noted to be in a state of decay, and construction of a concrete replacement was suggested as soon as funds were available.[194] The report also suggested that prior to the rebuilding of the dam, a sluiceway portion "should be provided to increase discharge capacity and reduce present danger of washout."[195] Construction of the sluiceway began in 1928, and was completed in 1929, at which time construction of a concrete spillway was begun.[196] By 1930, the rebuilding of the De Pere dam was completed.[197] The De Pere dam has been altered little since its completion in 1930, apart from the cleaning and painting of the sluice gates in 1947 and 1948.[198]

In 1934, plans were made to replace the composite lock at De Pere with a concrete lock with steel gates. Construction was scheduled to take place from December to March in 1934-1935, and was to be completed during the winter of 1935-1936.[199] By 1936, the concrete lock was in place. The De Pere lock configuration has been altered little since 1936 apart from periodic cleaning and painting of the gates and steelwork. Additional minor alterations include various repairs and improvements to the canal banks.[200]

SIGNIFICANCE

The development of the Fox-Wisconsin Waterway illustrates late 19th and early 20th century efforts to build a national transportation system linking the Midwest with the Atlantic seaboard. The Lower Fox River Lock and Dam System portion of the Waterway further represents an important historical link to 19th century attempts to develop Wisconsin's industrial infrastructure. The complex of locks and dams was designed to allow safe passage of commercial water traffic on 37 river miles of the Fox River from Lake Winnebago to Green Bay, Wisconsin. The system remains basically operational and is an example of a hand-operated lock and dam system. Construction incorporates all three major types of lock design including composite, cut masonry, and reinforced concrete structures. The Lower Fox River Lock and Dam System is thus a significant component of Wisconsin's historic industrial landscape and a link to the region's industrial and commercial history.

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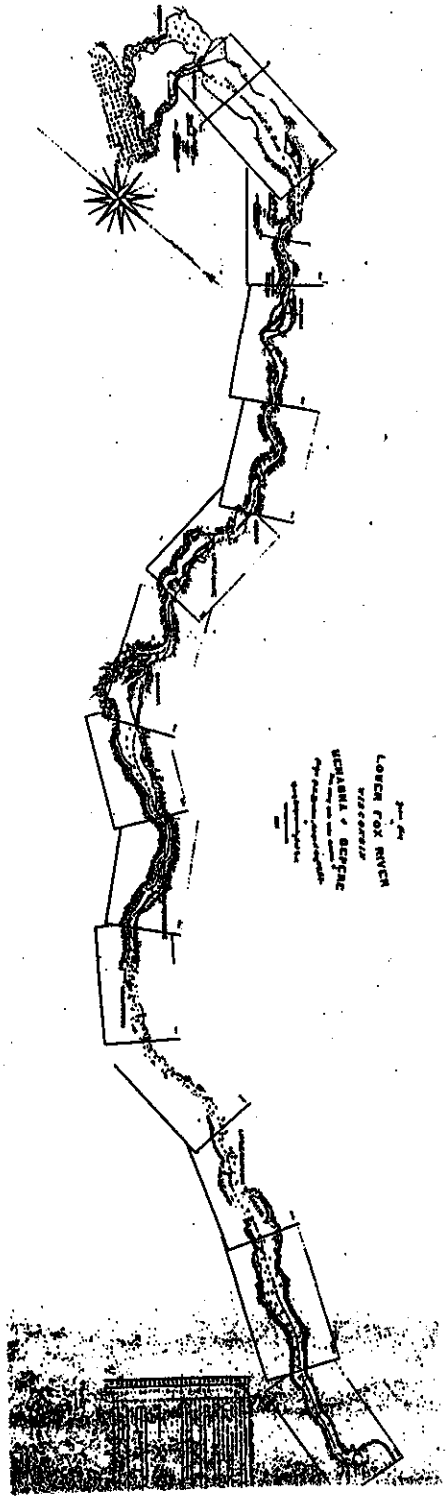
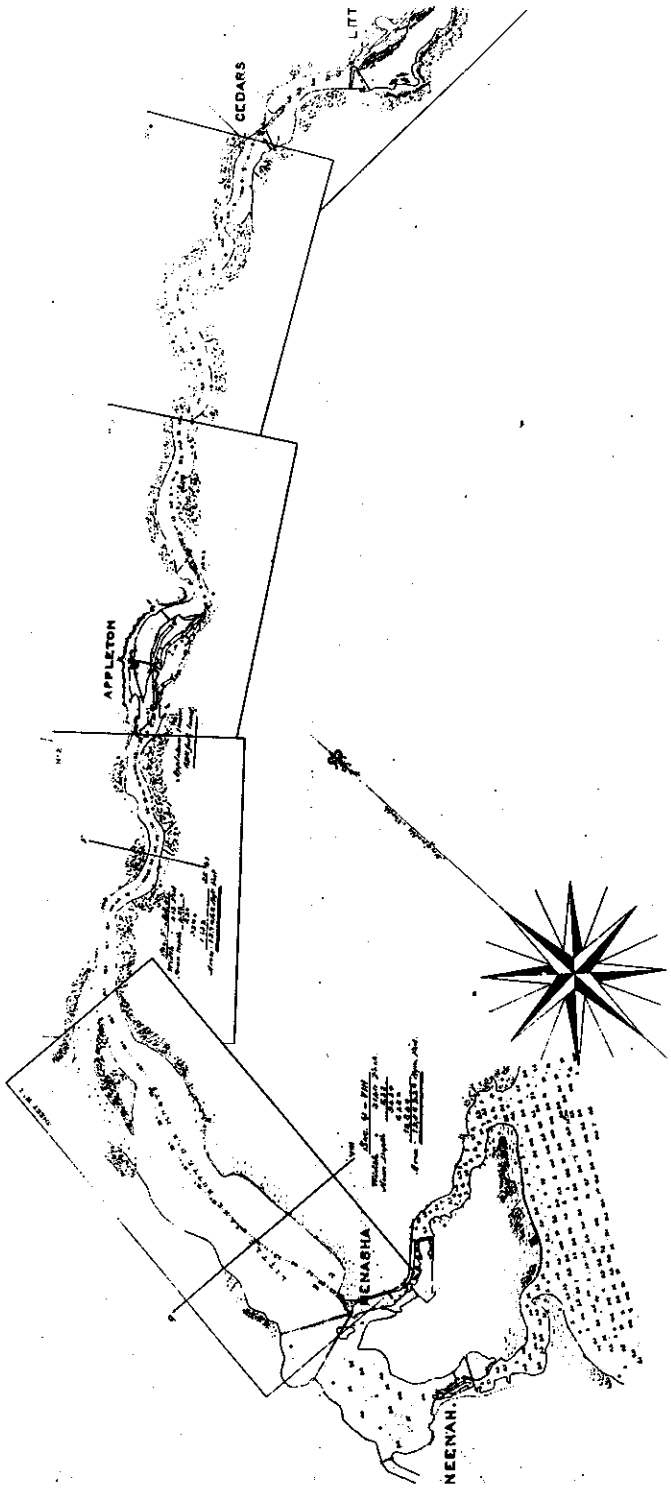
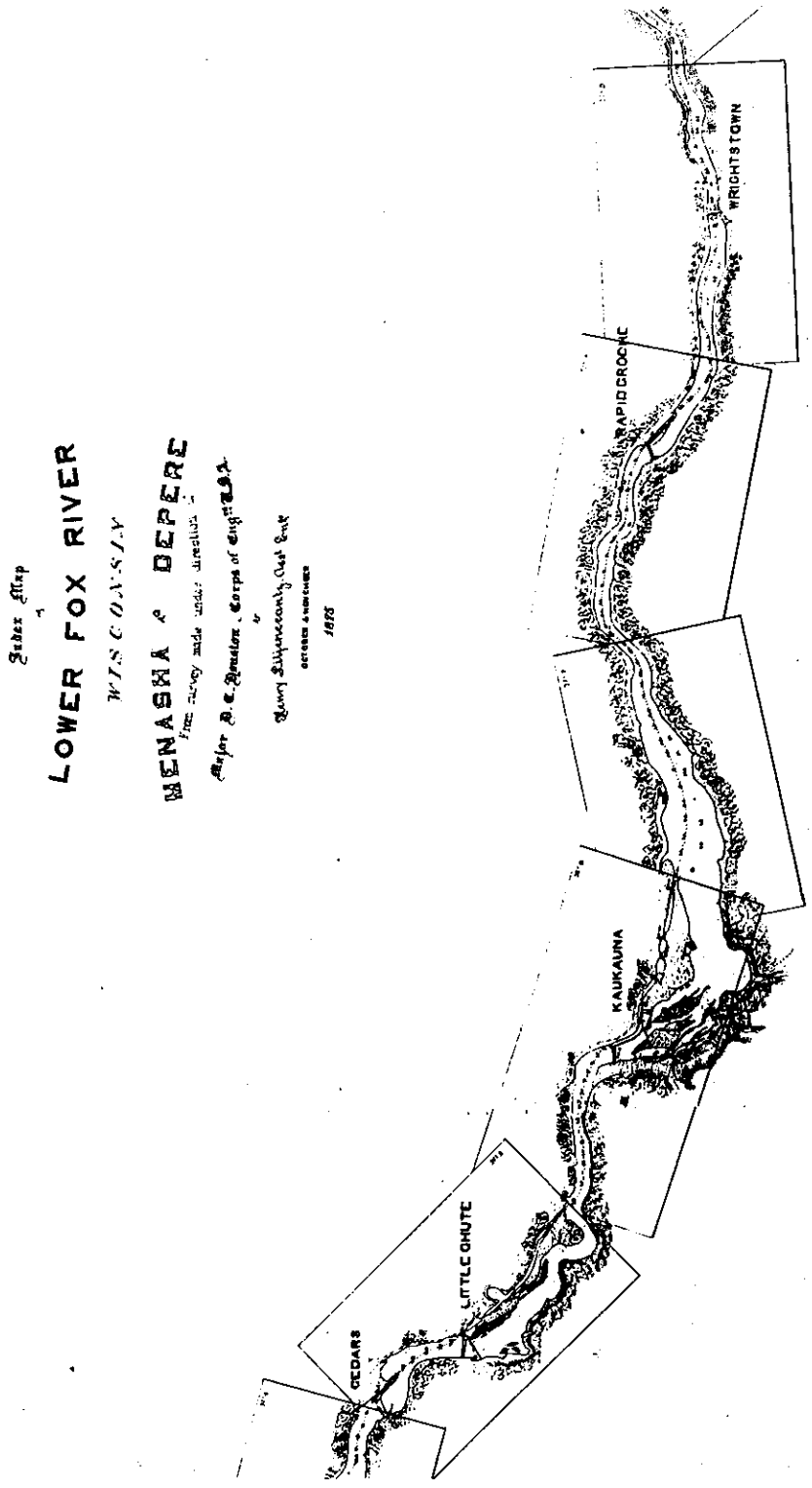


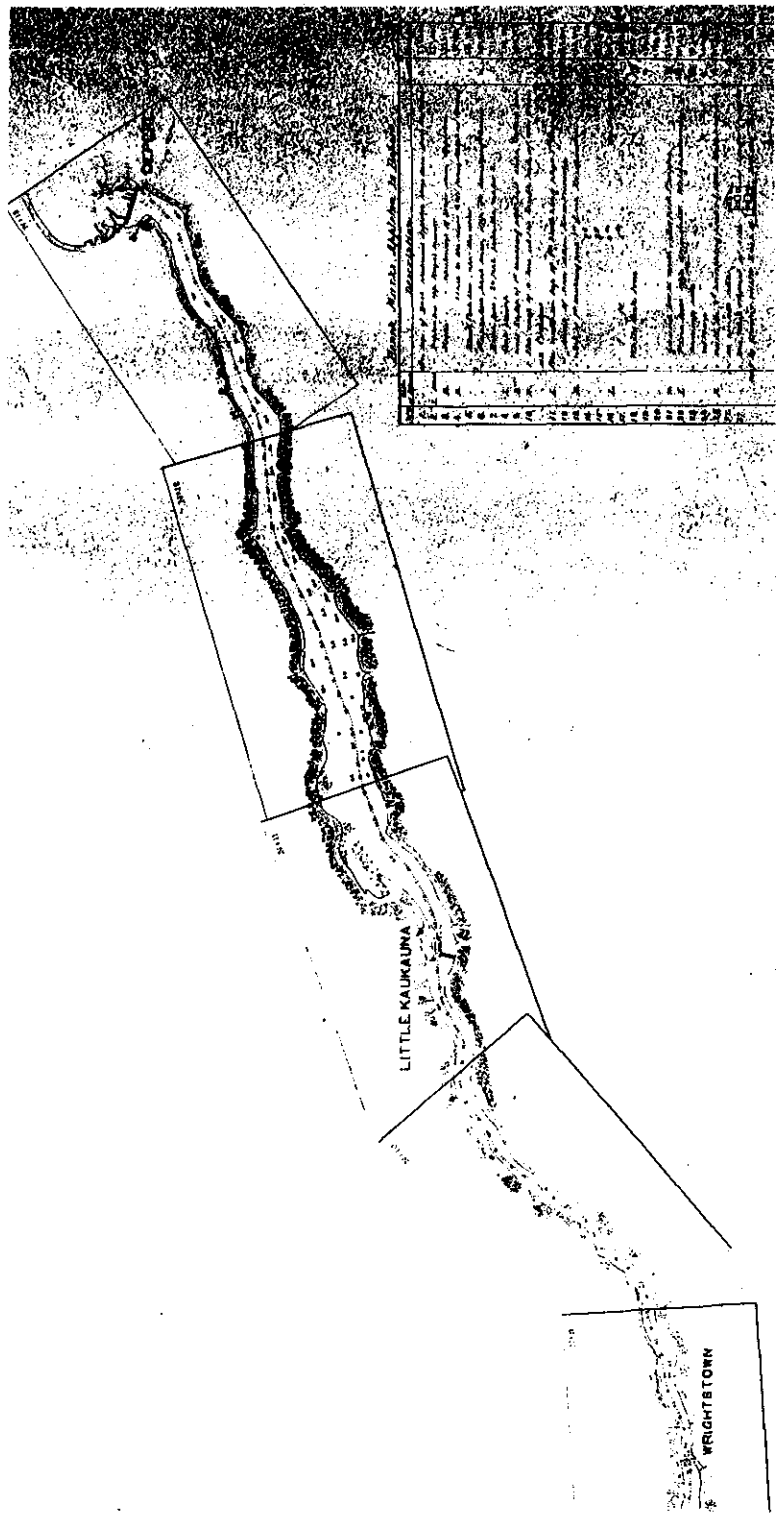
Index Map of Lower Fox River Wisconsin, Menasha to De Pere, Henry Liljencrantz, Asst. Engr., Corps of Engineers, U.S.A., October & November, 1875.



Map of Lower Fox River Wisconsin, Menasha to De Pere, Henry Liljencrantz, Asst. Engr., Corps of Engineers, U.S.A., October & November, 1875, sheet 1 of 3.



Map of Lower Fox River Wisconsin, Menasha to De Pere, Henry Liljencrantz, Asst. Engr., Corps of Engineers, U.S.A., October & November, 1875, sheet 2 of 3.



Map of Lower Fox River Wisconsin, Menasha to De Pere, Henry Liljencrantz, Asst. Engr., Corps of Engineers, U.S.A., October & November, 1875, sheet 3 of 3.

MAPS,

showing the

Canals, Locks, Dams, and Water-power Lots,

of the

Fox and Wisconsin Improvement Co.

Surveyed by W.S.Nearing, Assistant Engineer,

under direction of

Daniel C. Jenne Chief Engineer.

1859.

—NOTE—

The red line is the base of survey. The full red transverse lines indicate angles, and the blue line the outer bounds of land appropriated for the benefit, and use of the Improvement. The figures on the dotted red transverse lines indicate distances from the last angle, those on the full red transverse lines the lengths of the preceding courses, and those along the blue line its distance from the base. The Waterpower Lots are numbered with small figures, and the Blocks with large figures.

Note.

The Water Power Lots are tinted in yellow. . . .

—SCALE—

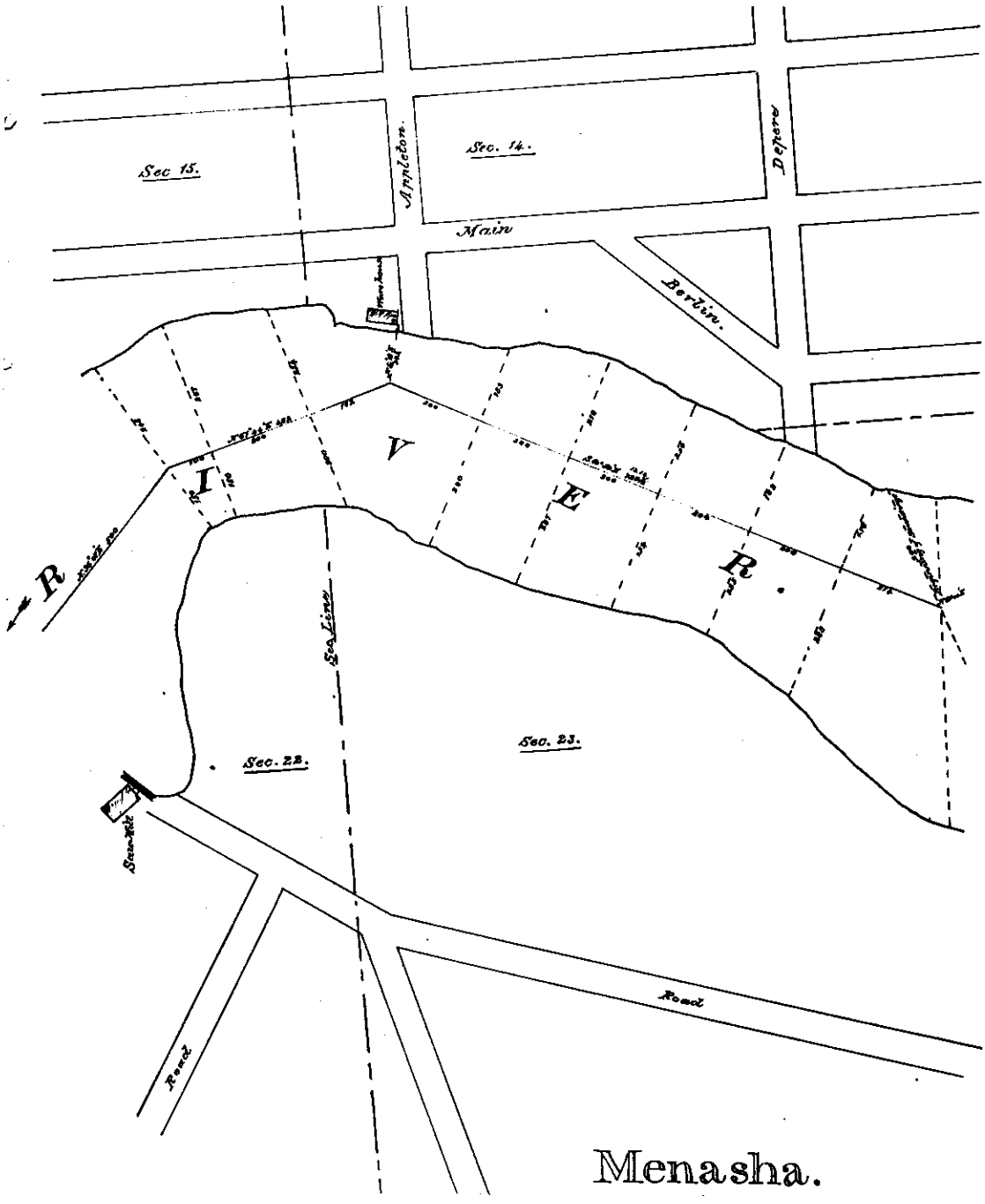
100 feet to ¼ of an inch.

Addenda.

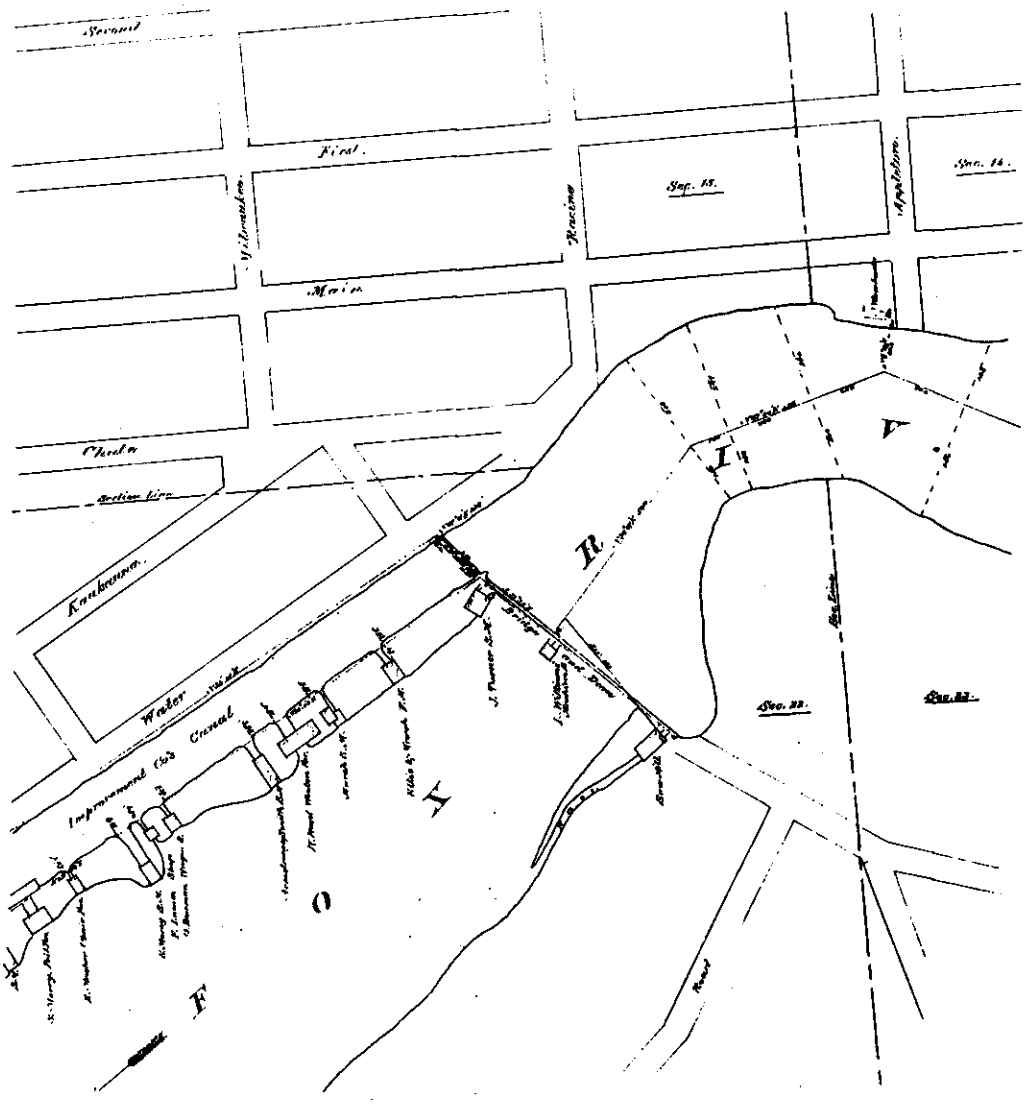
The accompanying Maps were errored in 1893 [illegible] the originals, which are now [illegible] property of the Green Bay & Mississippi Canal Co.

W. S. Nearing
Assist. Engineer

Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, Title Page, sheet 1 of 20.



Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 2 of 20.



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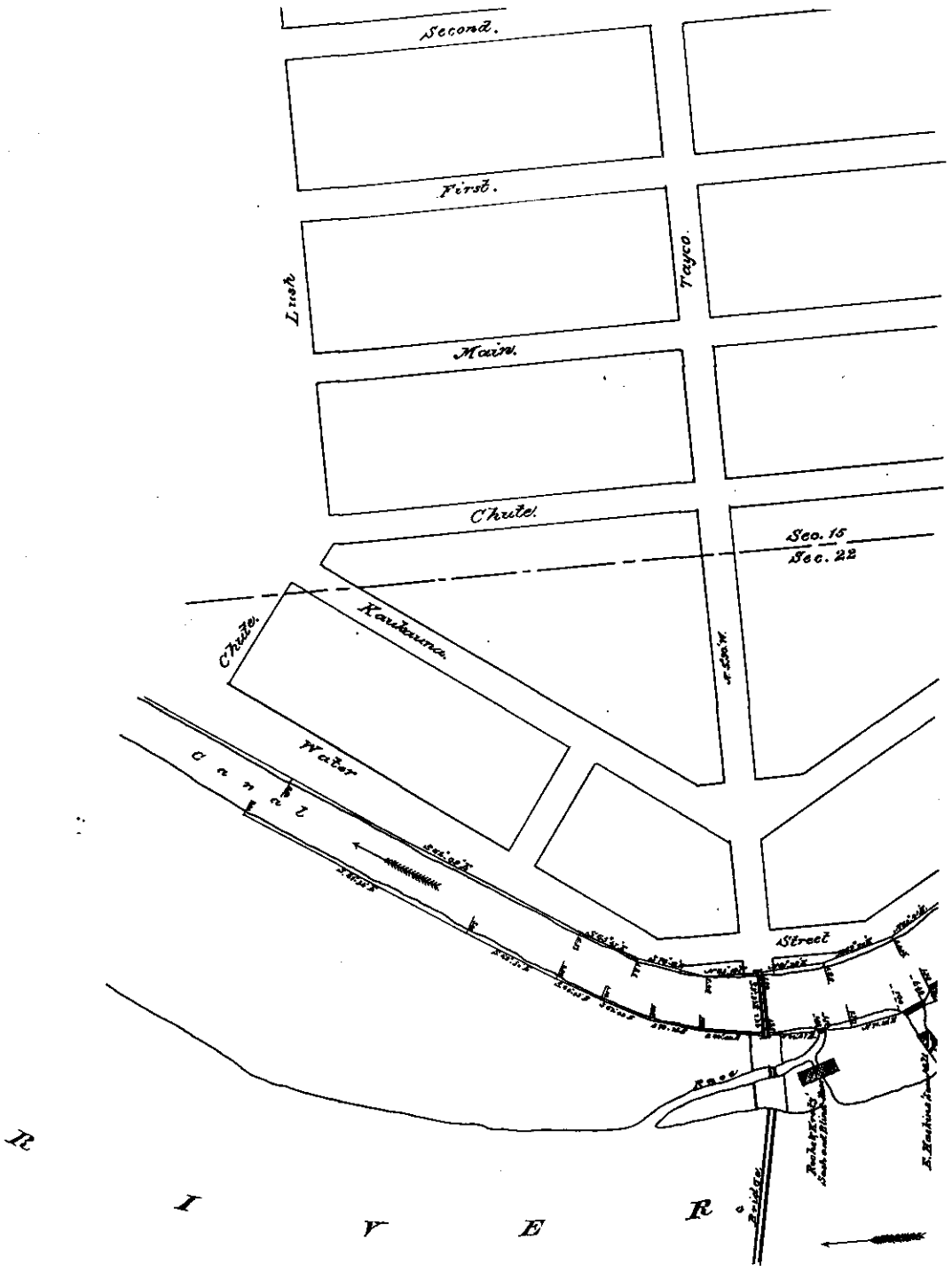
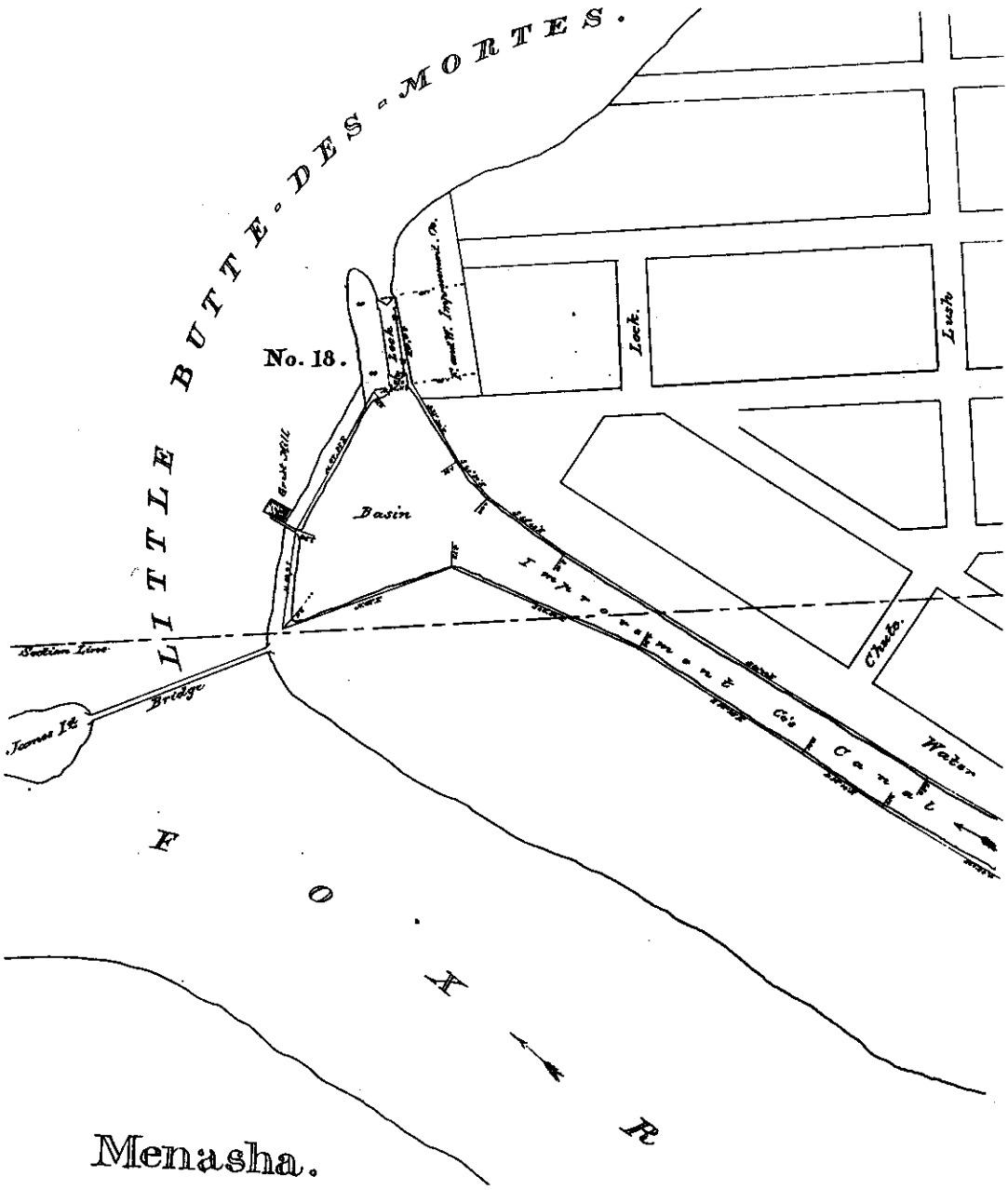
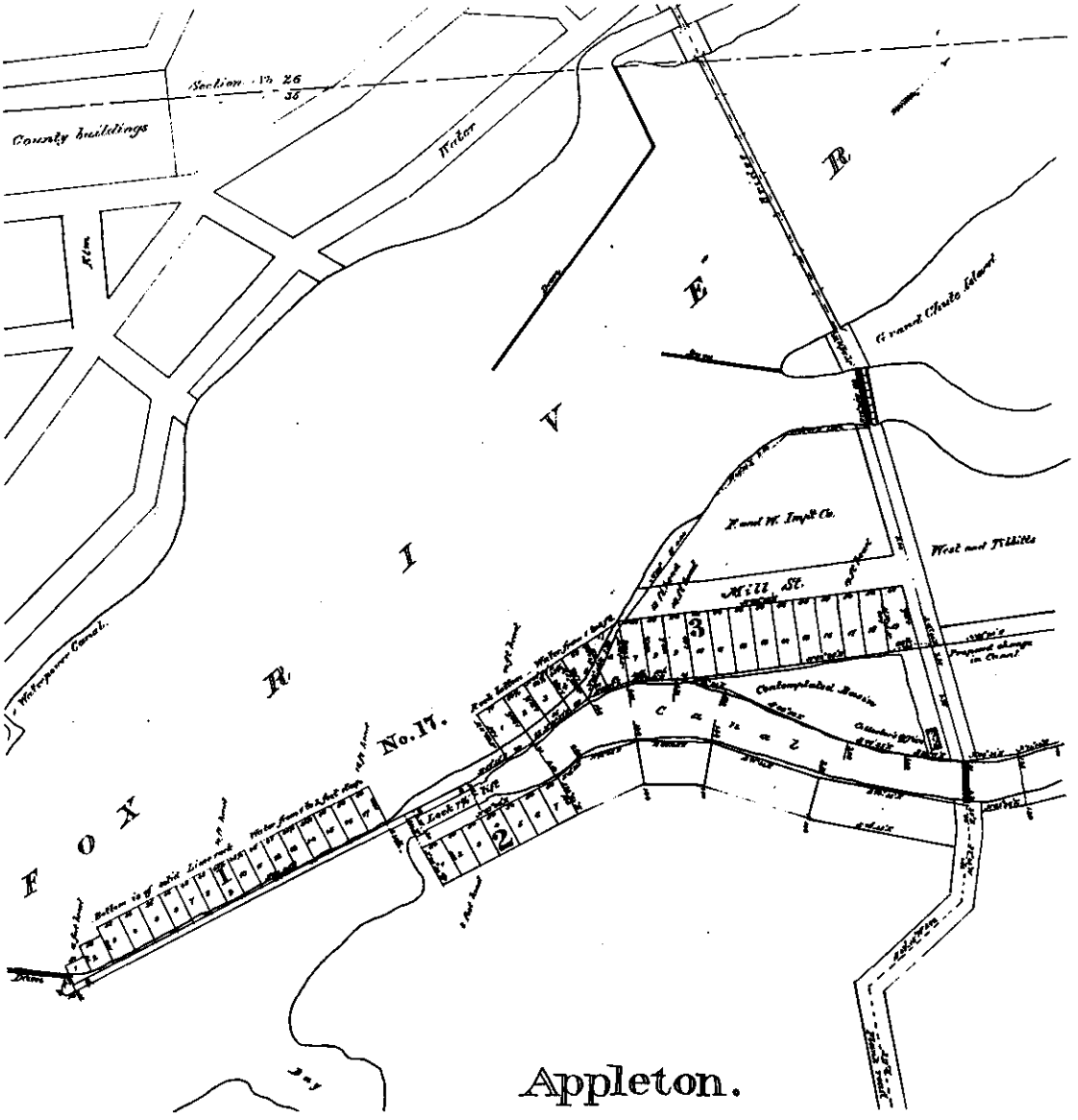


Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 4 of 20.



Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 5 of 20.



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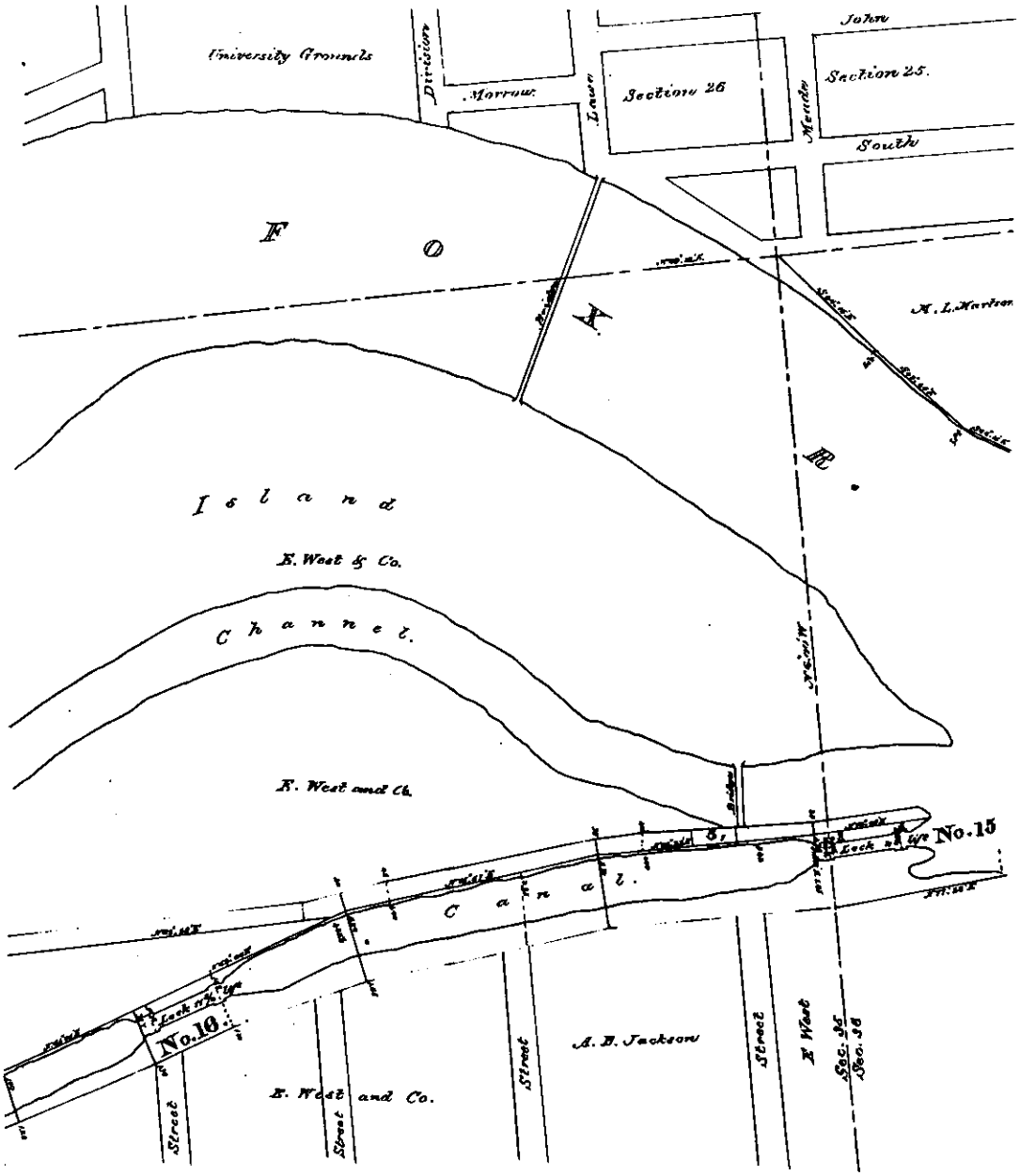

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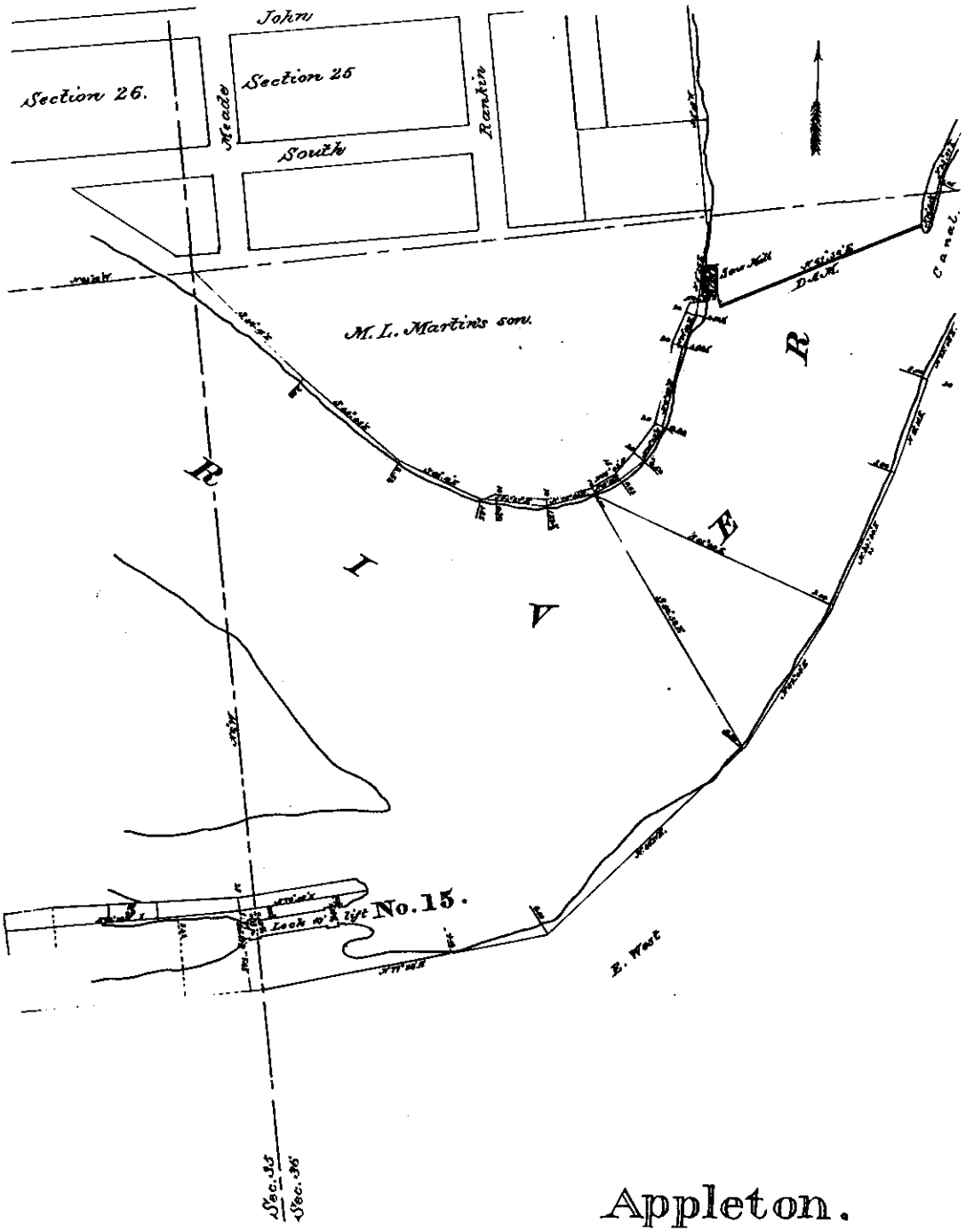

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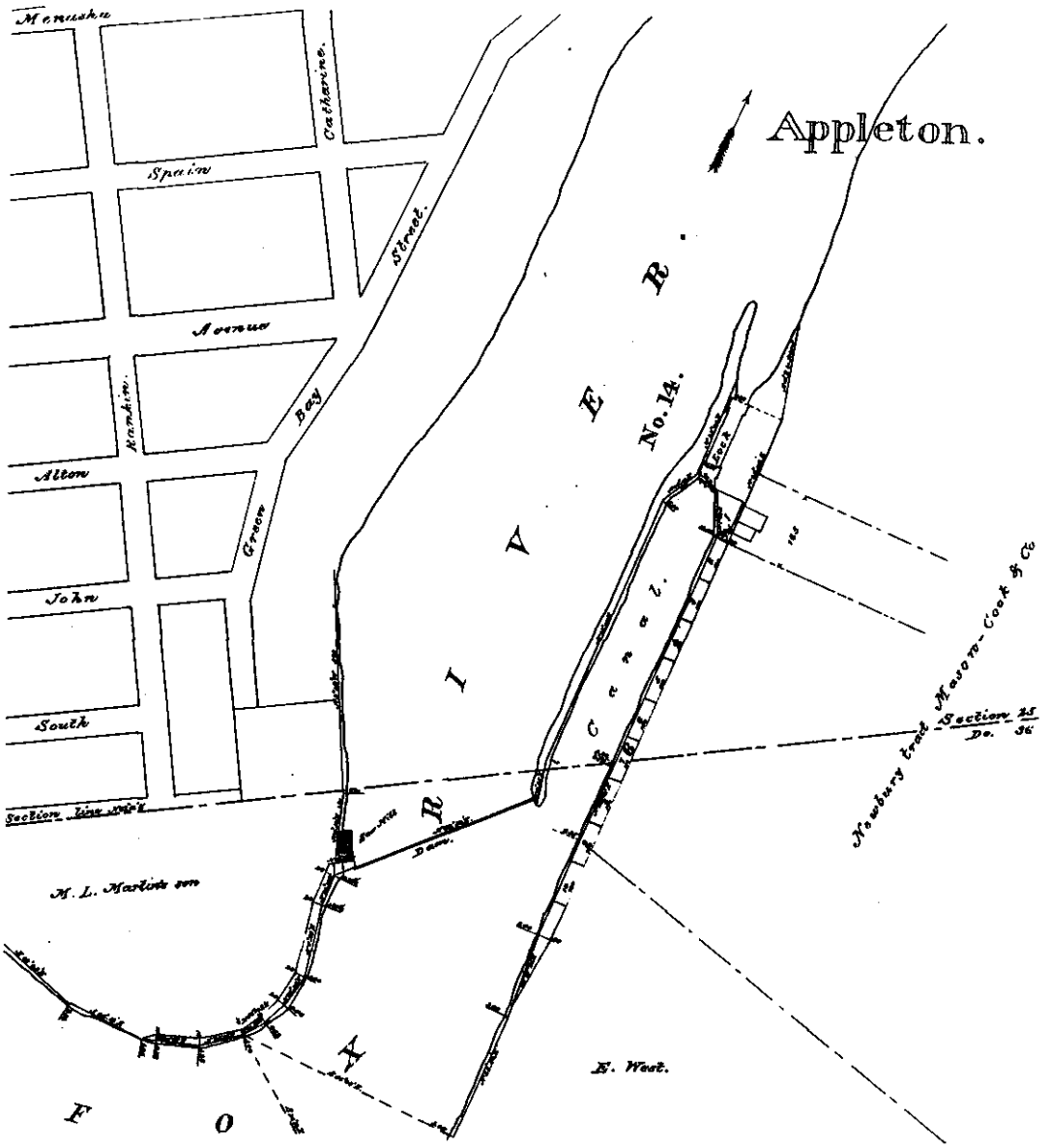

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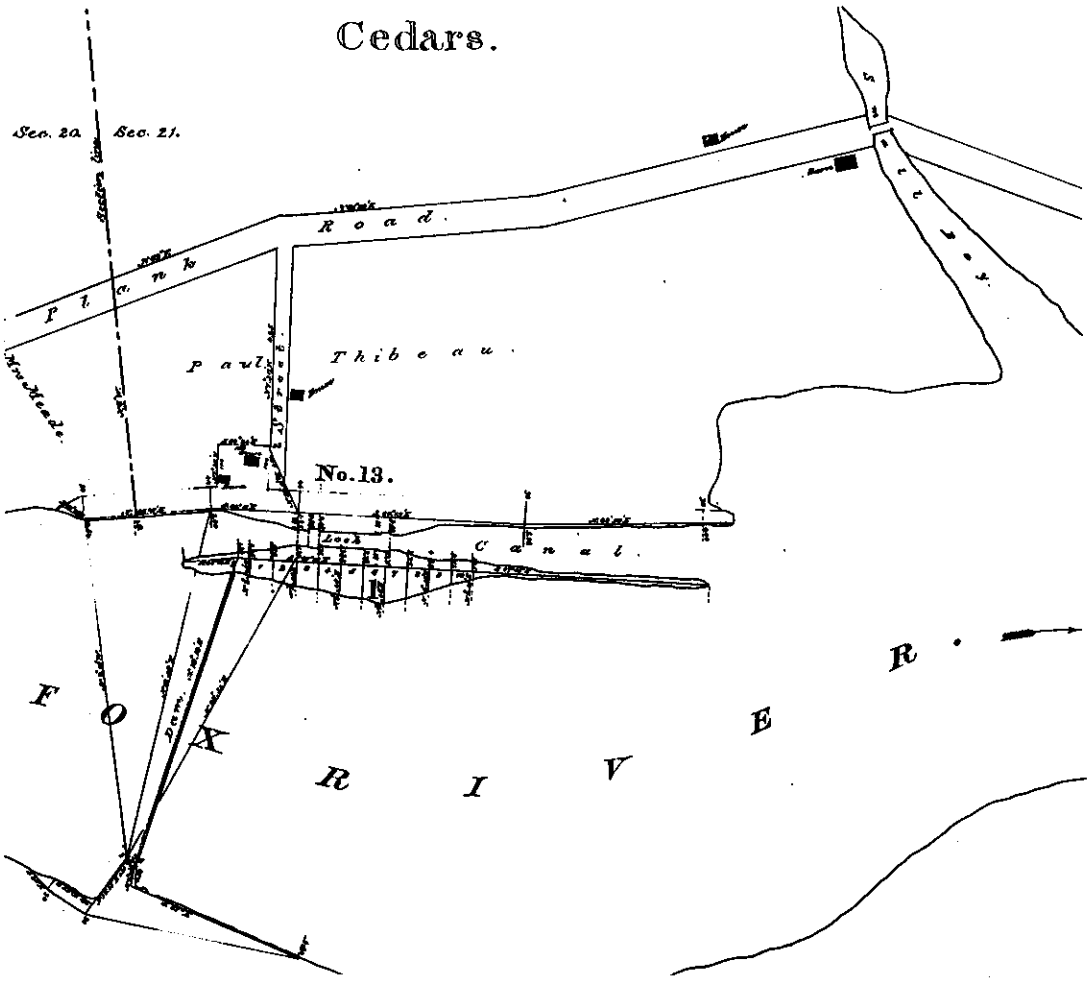
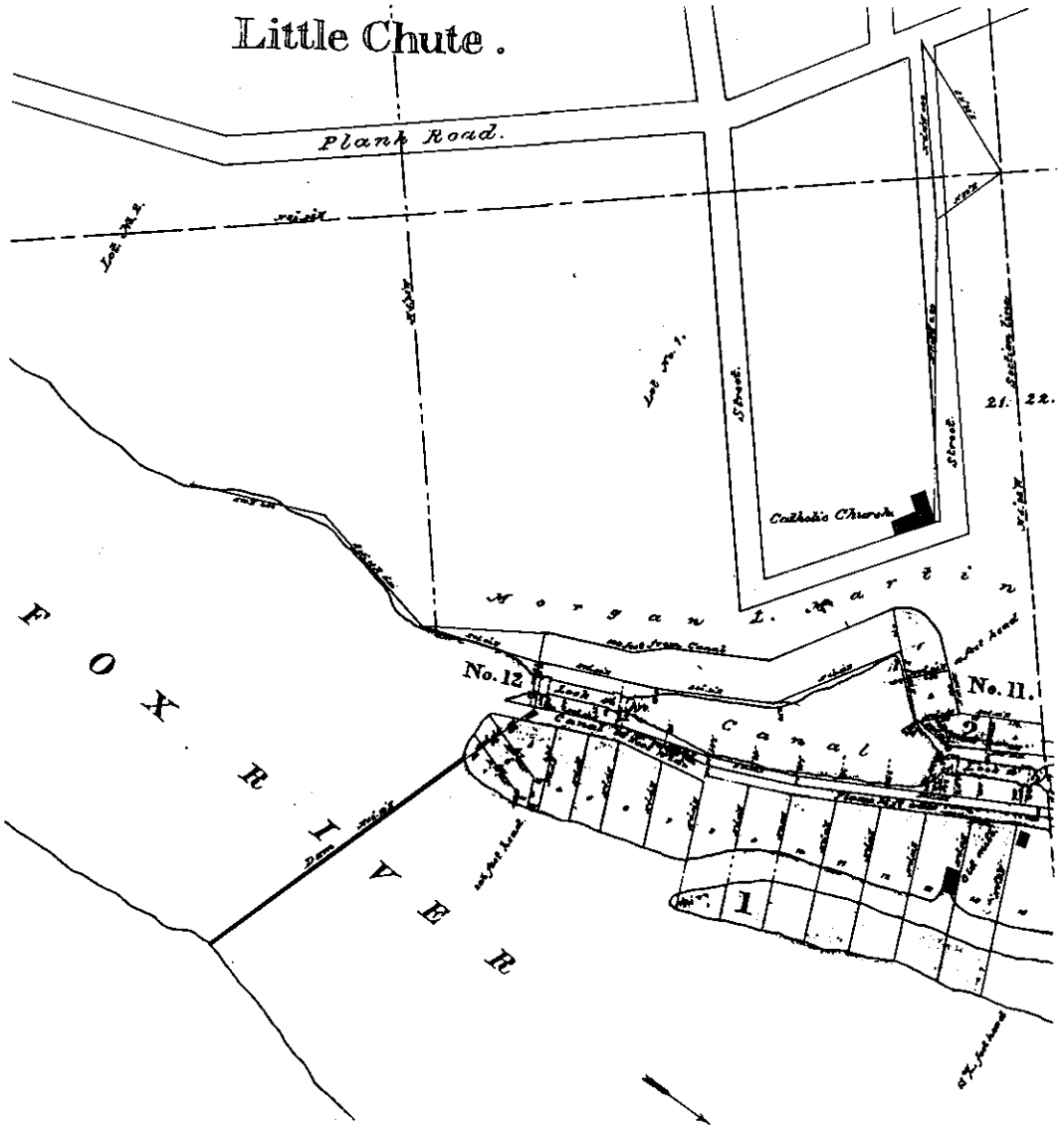


Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 10 of 20.



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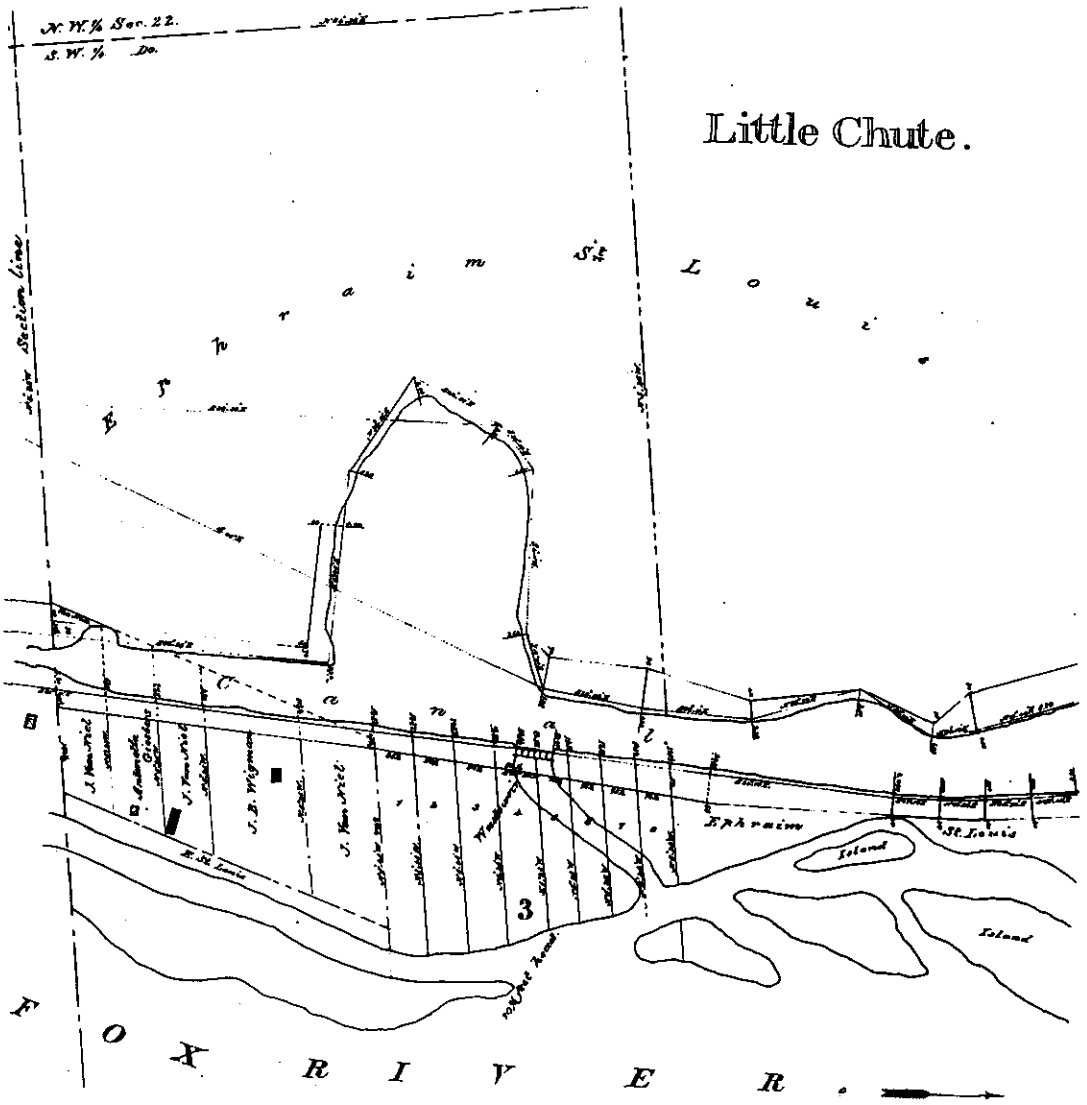

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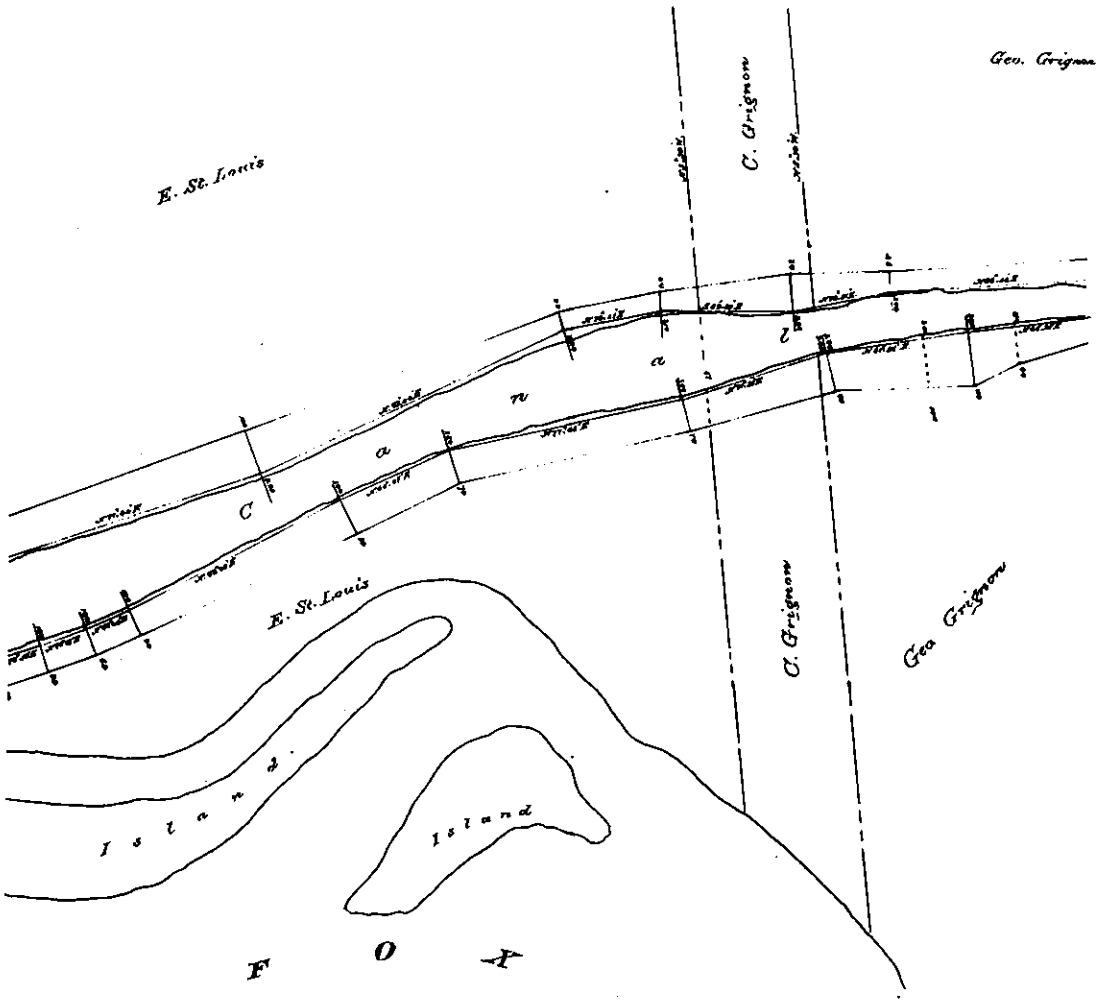
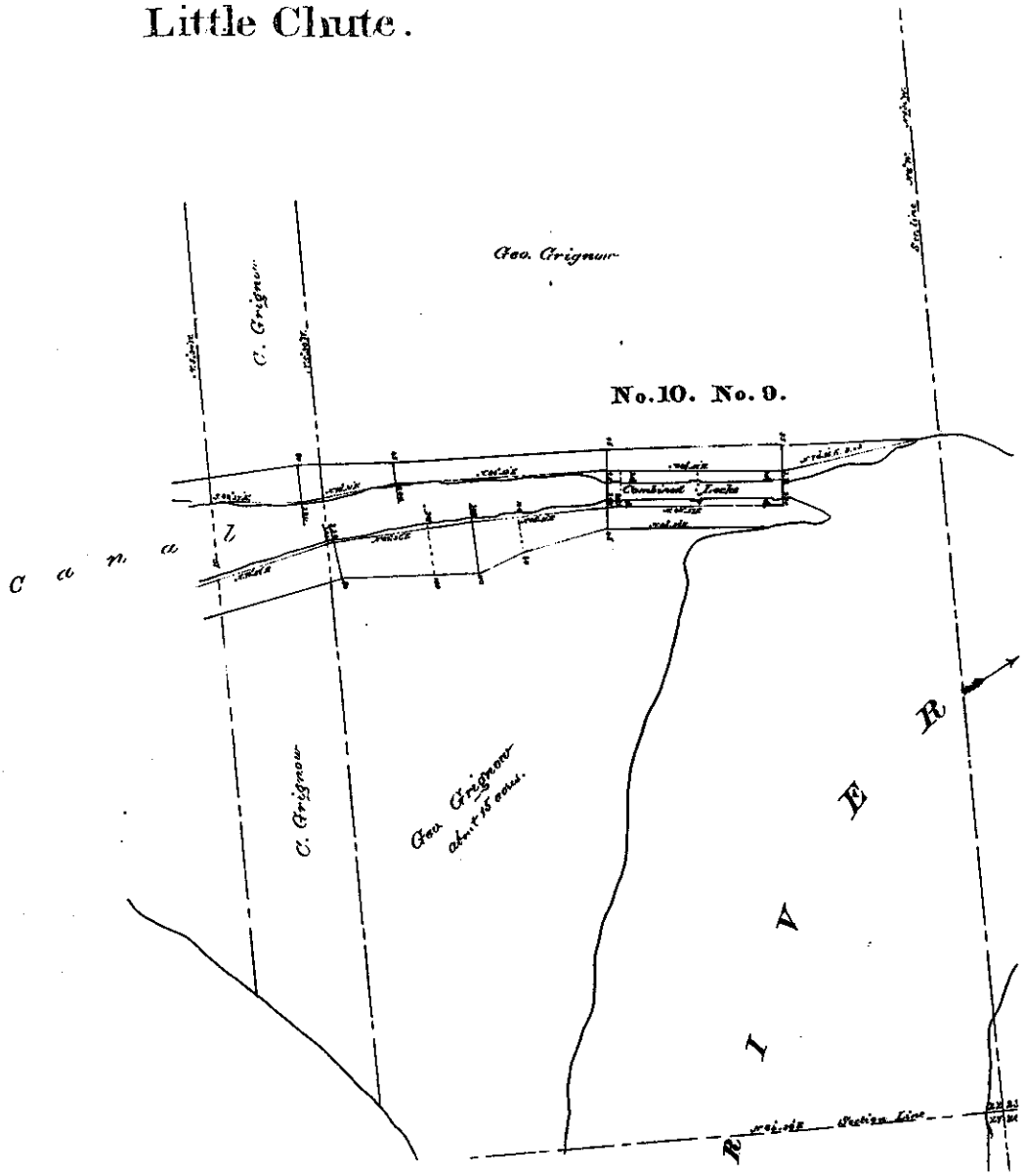


Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 13 of 20.



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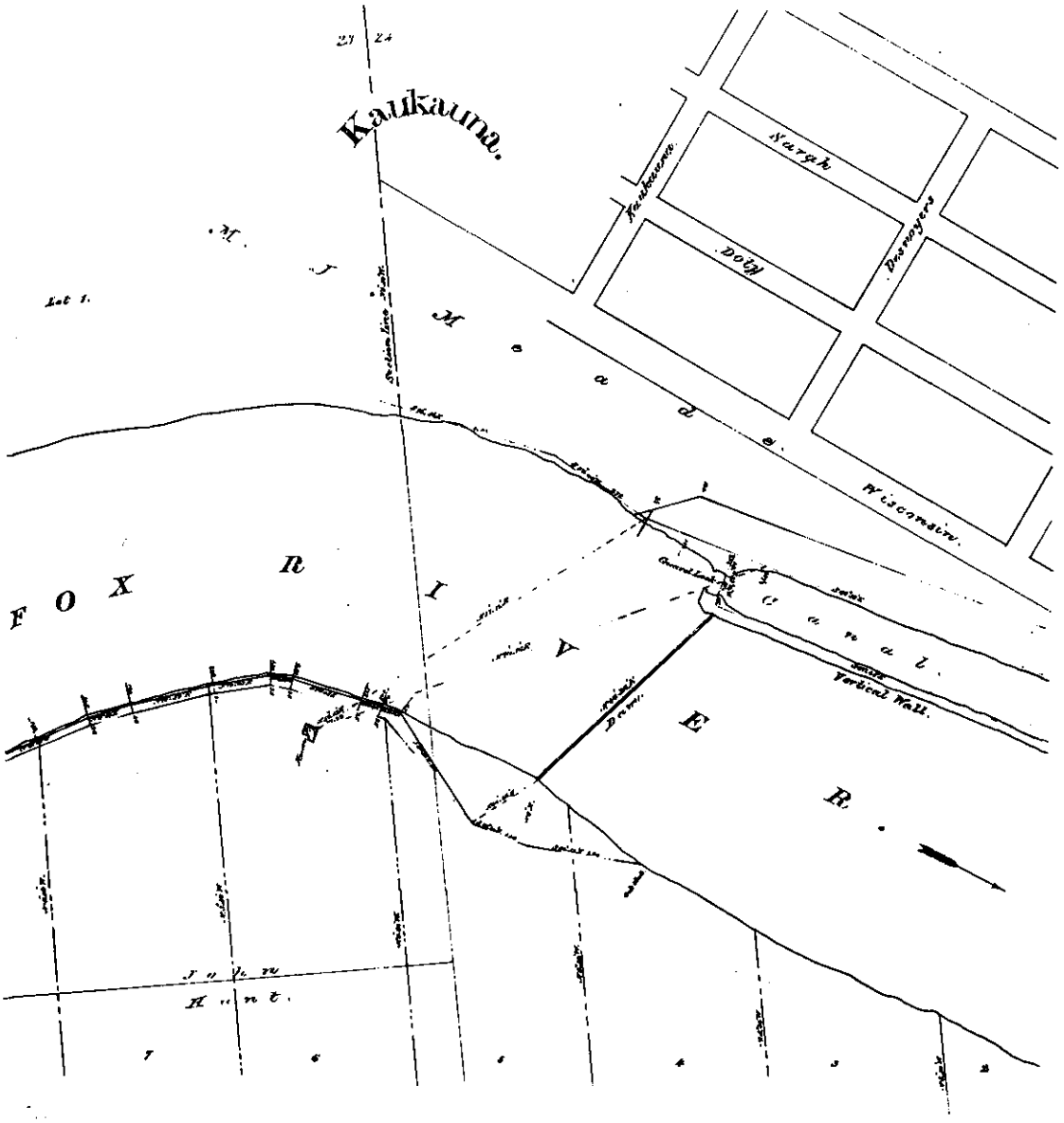

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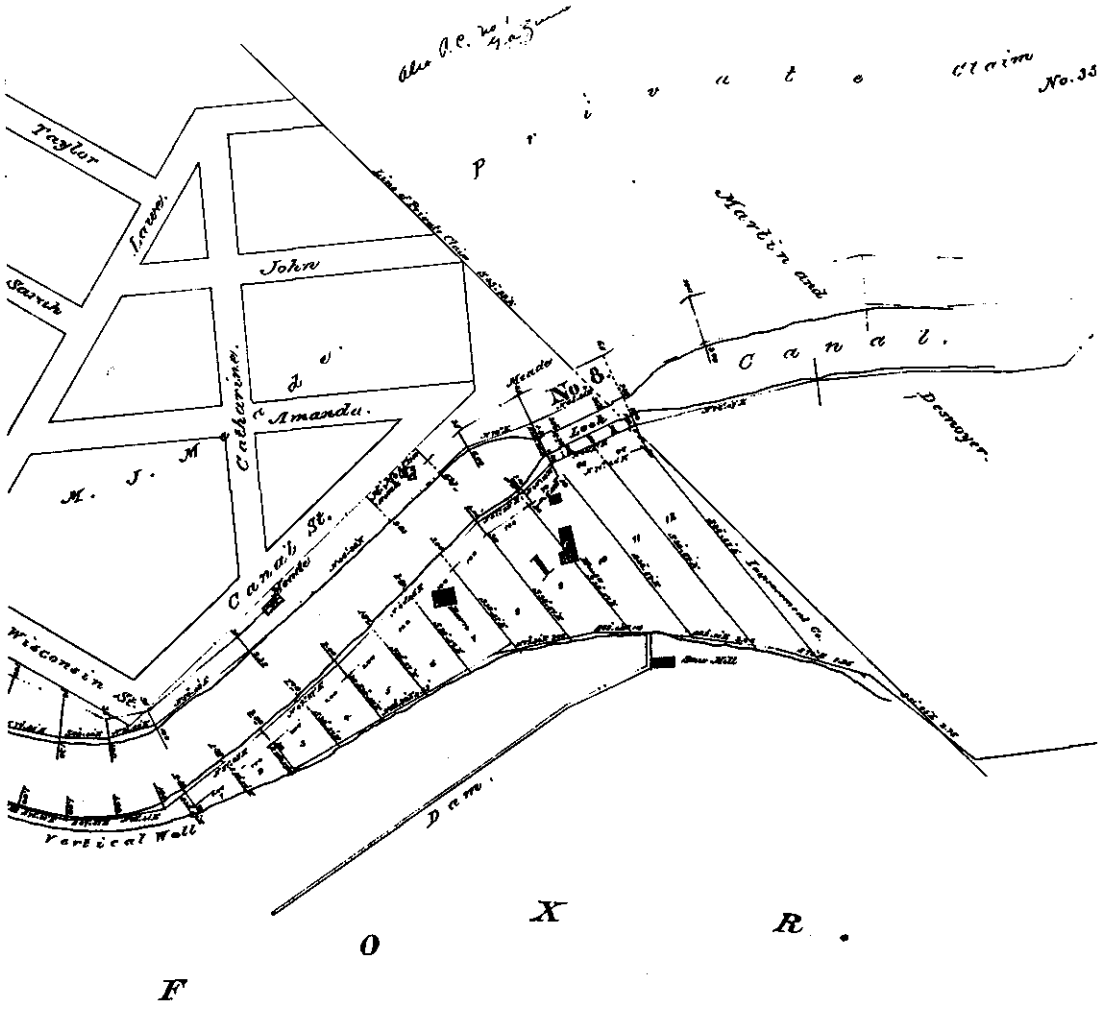

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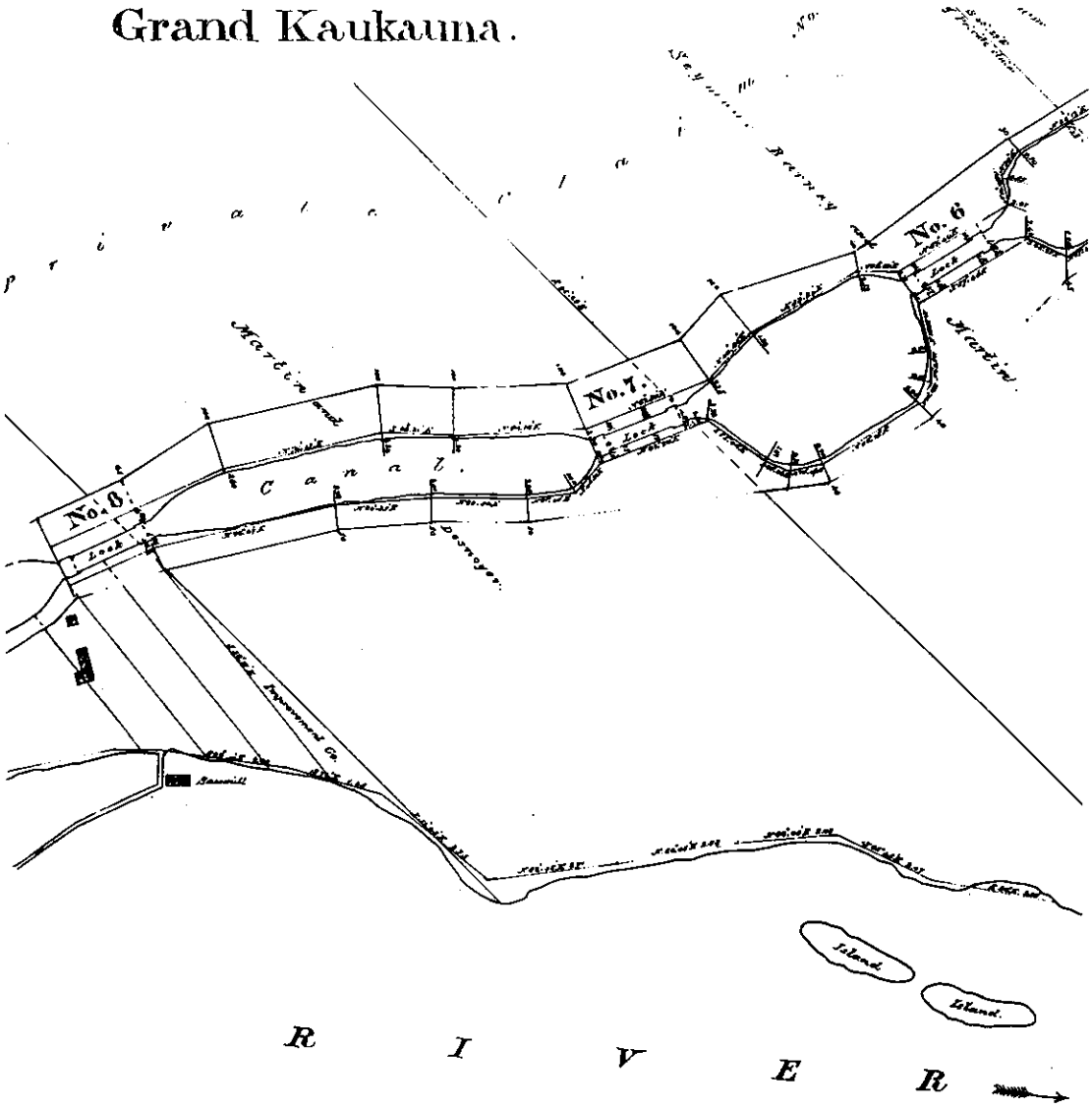

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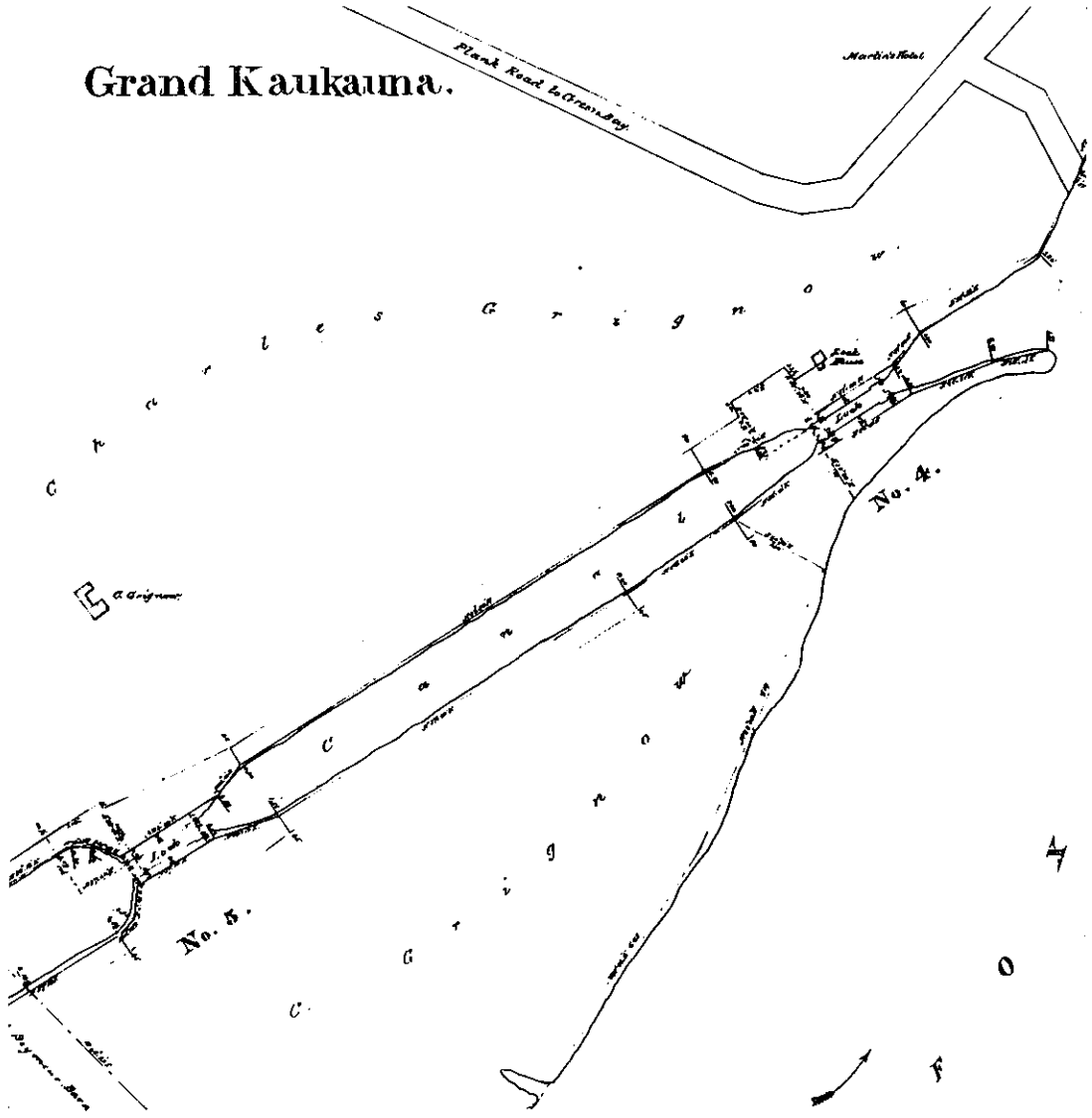

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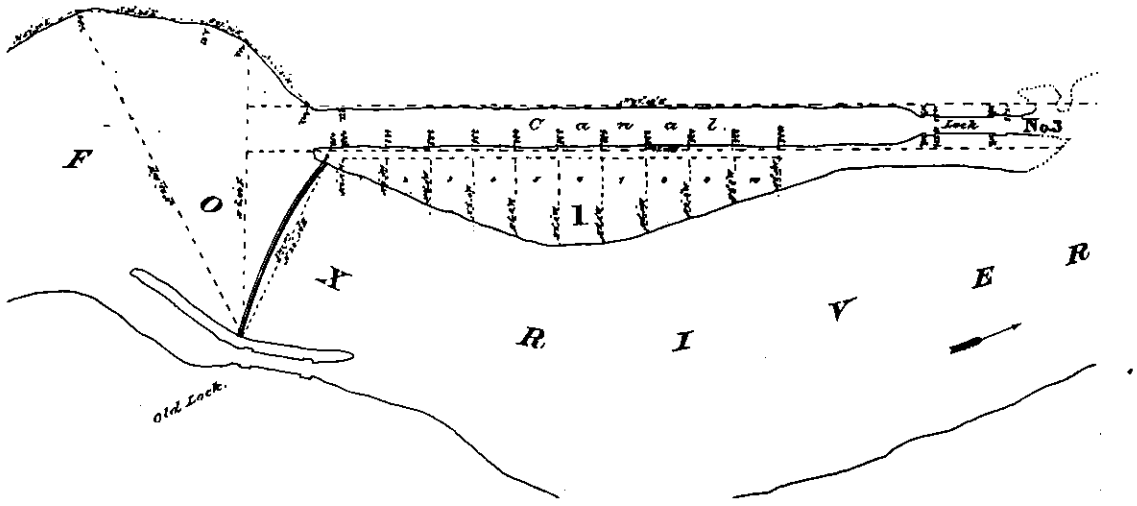
Rapide Croche



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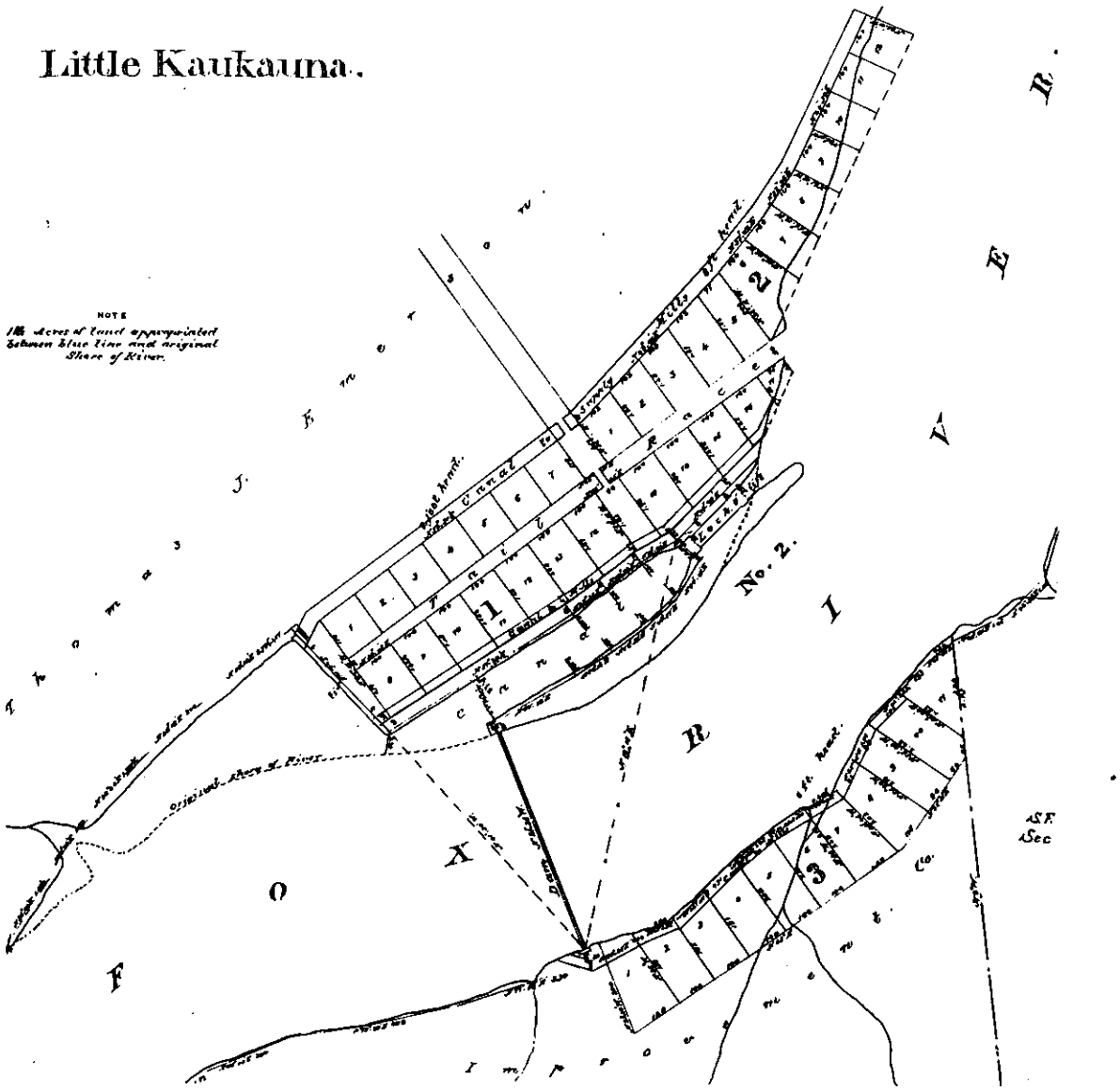
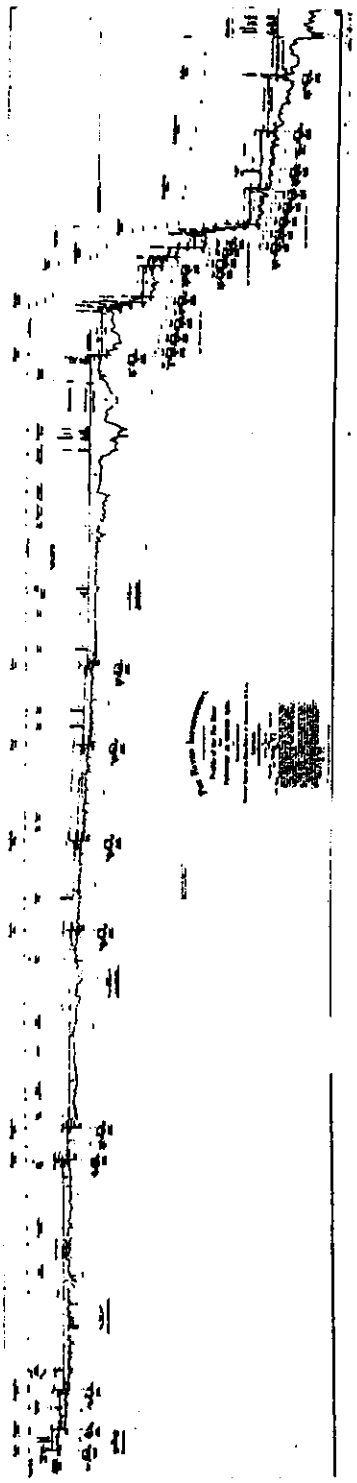
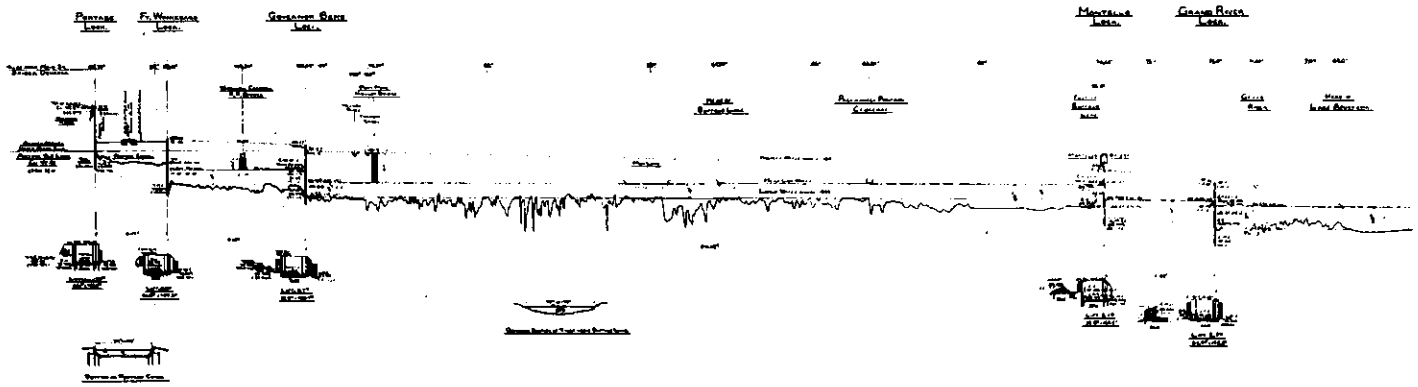


Map showing the canals, locks, dams and water-power lots, of the Fox and Wisconsin Improvement Co., W.S. Nearing, Assistant Engineer, Corps of Engineers, 1859, sheet 20 of 20.

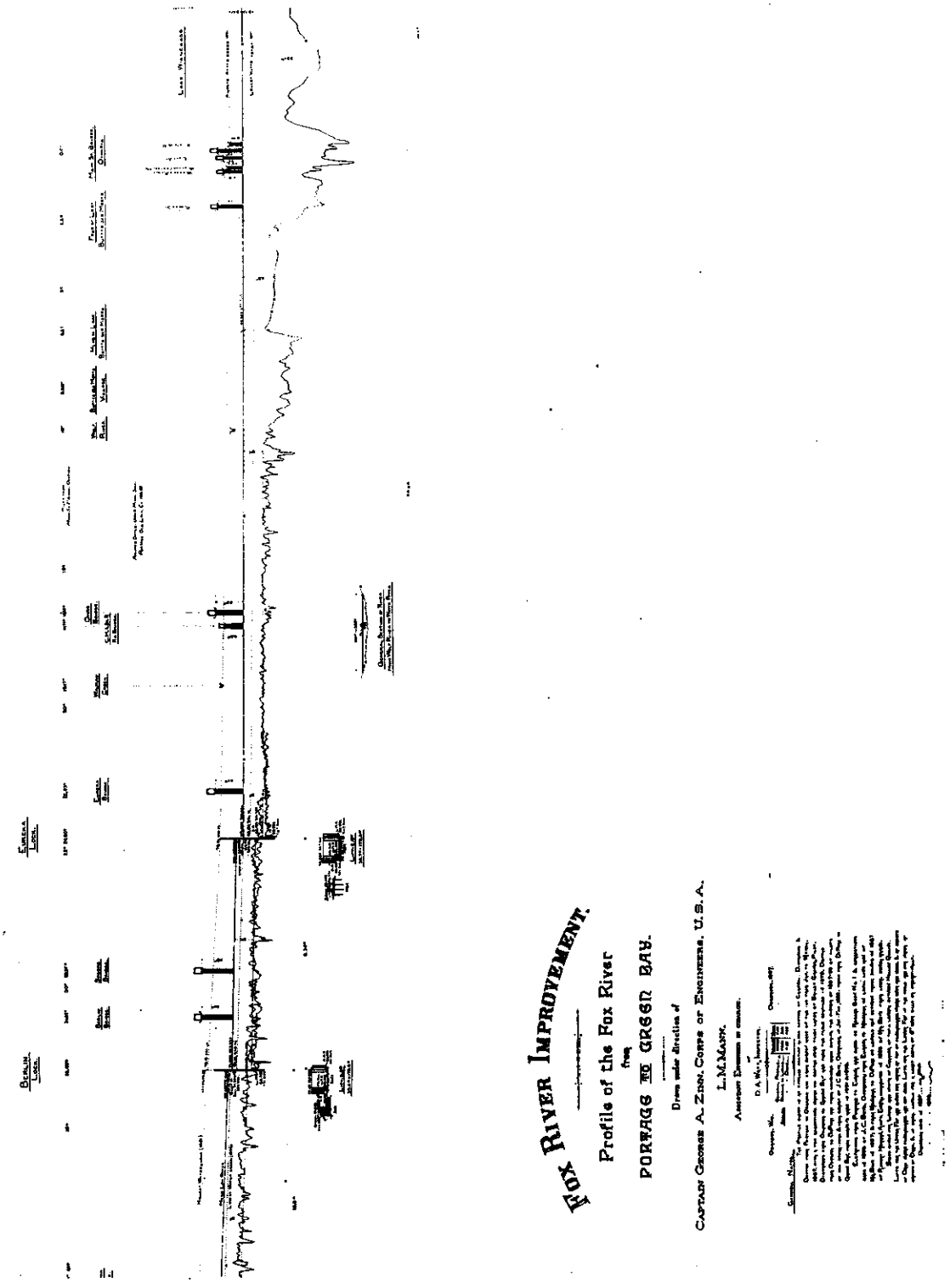


Fox River Improvement, Profile of the Fox River from Portage to Green Bay, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., December 1897.

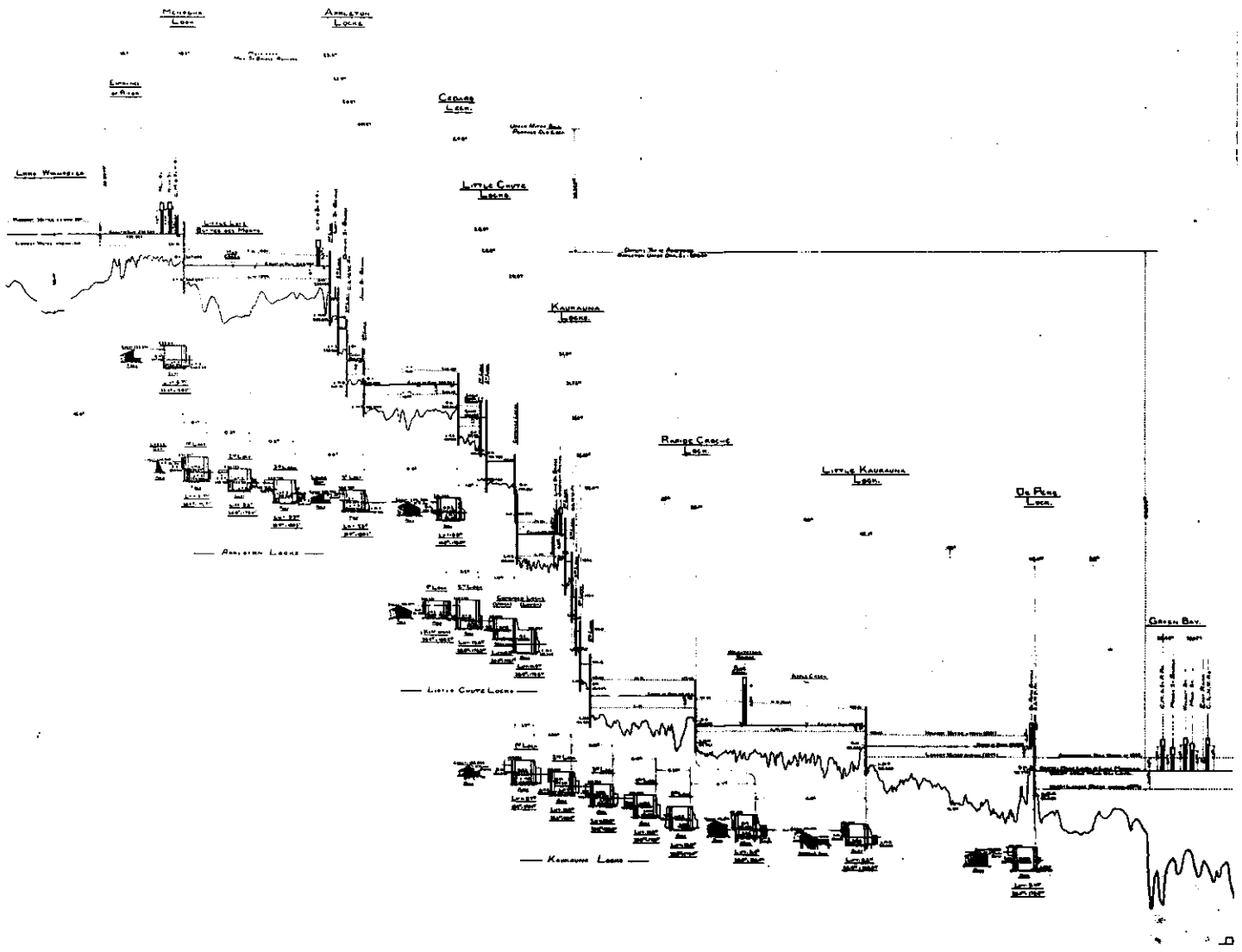


Fox River Improvement, Profile of the Fox River from Portage to Green Bay, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., December 1897, sheet 1 of 4.

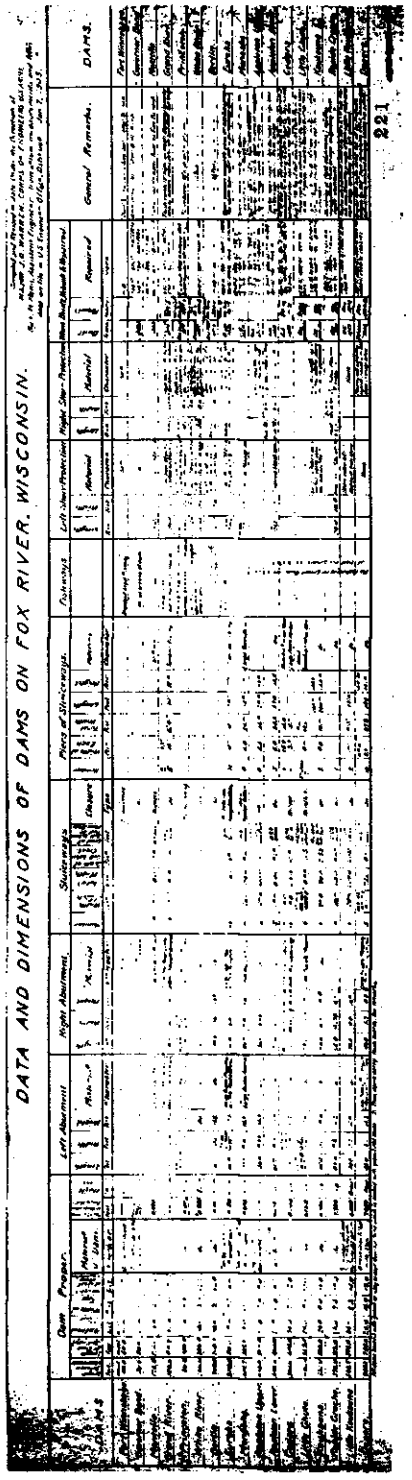
Fox River Improvement, Profile of the Fox River from Portage to Green Bay, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., December 1897, sheet 2 of 4.



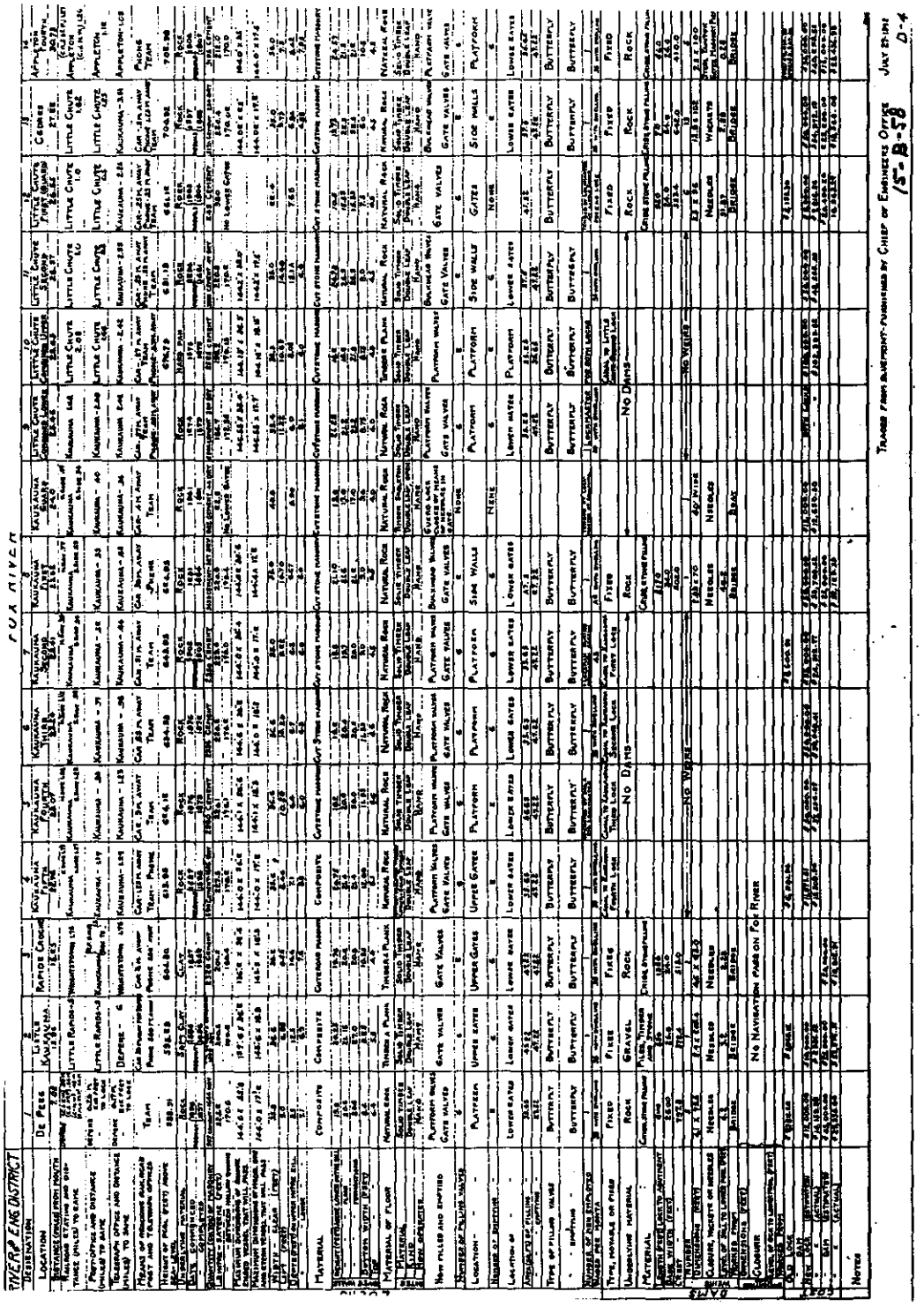
Fox River Improvement, Profile of the Fox River from Portage to Green Bay, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., December 1897, sheet 3 of 4.



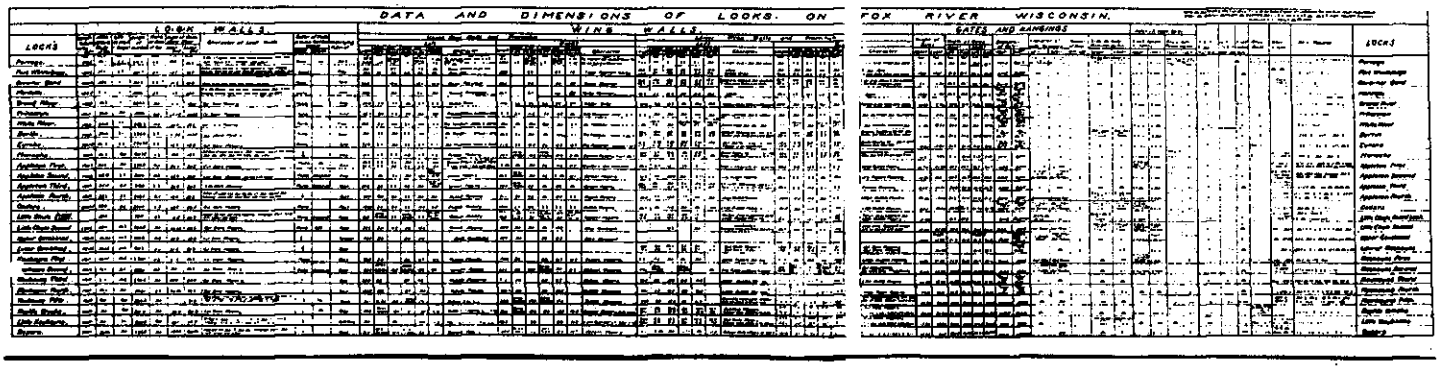
Fox River Improvement, Profile of the Fox River from Portage to Green Bay, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., December 1897, sheet 4 of 4.


DATA AND DIMENSIONS OF DAMS ON FOX RIVER, WISCONSIN.

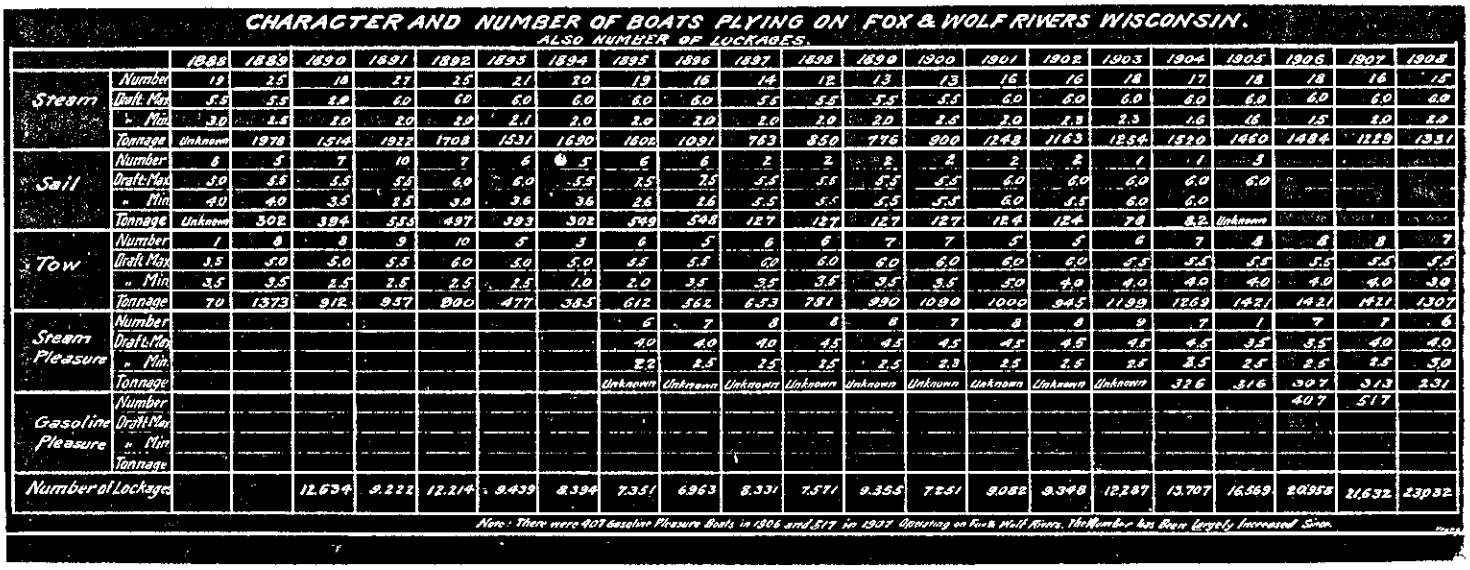
Data and Dimensions of Dams on Fox River, Wisconsin, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S. Army, Jan. 7, 1905.



Data for Fox River Facilities, July 27, 1913, File #15-B-58.


DATA AND DIMENSIONS OF LOCKS ON FOX RIVER WISCONSIN.

Data and Dimensions of Locks on Fox River, Wisconsin, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S. Army, March 22, 1904.



CHARACTER AND NUMBER OF BOATS PLYING ON FOX & WOLF RIVERS WISCONSIN.
ALSO NUMBER OF LOCKAGES.

		1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Steam	Number	19	25	18	27	25	21	20	13	16	14	12	13	13	16	16	18	17	18	18	16	15
	Draft: Max	5.5	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.5	5.5	5.5	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	" Min	3.0	2.5	2.0	2.0	2.0	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.0	2.3	2.3	1.6	1.6	1.5	2.0	2.0
	Tonnage	Unknown	1978	1514	1922	1708	1531	1690	1602	1091	763	850	776	900	1248	1163	1254	1520	1460	1484	1229	1331
Sail	Number	8	5	7	10	7	6	5	6	6	2	2	2	2	2	2	1	1	3			
	Draft: Max	5.0	5.5	5.5	5.5	6.0	6.0	5.5	7.5	7.5	5.5	5.5	5.5	5.5	6.0	6.0	6.0	6.0	6.0			
	" Min	4.0	4.0	3.5	2.5	3.0	3.6	3.6	2.6	2.6	5.5	5.5	5.5	5.5	6.0	5.5	6.0	6.0				
	Tonnage	Unknown	302	394	555	497	393	302	549	548	127	127	127	127	124	124	78	82	Unknown			
Tow	Number	1	0	0	0	0	0	3	0	5	6	6	7	7	5	5	6	7	4	4	8	7
	Draft: Max	3.5	5.0	5.0	5.5	6.0	5.0	5.0	5.5	5.5	6.0	6.0	6.0	6.0	6.0	6.0	5.5	5.5	5.5	5.5	5.5	5.5
	" Min	3.5	3.5	2.5	2.5	2.5	2.5	1.0	2.0	3.5	3.5	3.5	3.5	3.5	5.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
	Tonnage	70	1373	912	957	900	477	385	612	562	653	781	990	1090	1000	945	1199	1263	1421	1421	1421	1307
Steam Pleasure	Number								6	7	8	8	8	7	8	8	9	7	1	7	7	6
	Draft: Max								4.0	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	3.5	3.5	4.0	4.0
	" Min								2.2	2.5	2.5	2.5	2.5	2.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.0
	Tonnage								Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	326	316	307	313	231
Gasoline Pleasure	Number																			407	517	
	Draft: Max																					
	" Min																					
	Tonnage																					
Number of Lockages				12,634	9,222	12,214	9,439	8,394	7,351	6,963	8,331	7,571	9,355	7251	9,082	9,348	12,287	13,707	16,569	20,958	21,632	23,032

Note: There were 407 Gasoline Pleasure Boats in 1906 and 517 in 1907 Operating on Fox & Wolf Rivers. The Number has Been Largely Increased Since.

Character and Number of Boats Plying on Fox and Wolf Rivers Wisconsin, circa 1909, Young.

Data for Raising Locks on Lower Fox River

Little Kaukauna Lock

Lengths for Turnbuckle Cover Plates

Left Wall-Upper End	Right Wall-Upper End
Back- 4'-8"	Back- 4'-8"
Front- 8'-10"	Front- 7'-11"
Left Wall-Lower End	**Right Wall-Lower End**
Back- 5'-7"	Back- 5'-11"
Front- 8'-9"	Front- 8'-6"

Heights for Precast Concrete Blocks

At upper left front gooseneck	1'-10 1/2"
" " " back "	1'-10 7/8"
" " right front "	1'-10 7/8"
" " " back "	1'-11 1/2"
" lower left front "	2'-0 7/8"
" " " back "	2'-0"
" " right front "	2'-0 3/8"
" " " back "	1'-11 3/8"

Little Chute Guard Lock

Left Wall	Right Wall
Back- 5'-6"	Back- 5'-6"
Front- 5'-9"	Front- 5'-8"

At left front gooseneck	1'-7 1/4"
" " back "	1'-6 5/8"
" right front "	1'-6 1/2"
" " back "	1'-6 1/2"

Cedars Lock

Cover plates (9" wide) in place over turnbuckles

At upper front left gooseneck	1'-3 1/8"
At " back " "	1'-3 3/8"
" " right front "	1'-2 7/8"
" " " back "	1'-3"
" lower left front "	1'-2 5/8"
" " " back "	1'-2 1/8"
" " right front "	1'-3 1/2"
" " " back "	1'-2 1/2"

Appleton Fourth Lock

Cover plates (9" wide) in place over turnbuckles

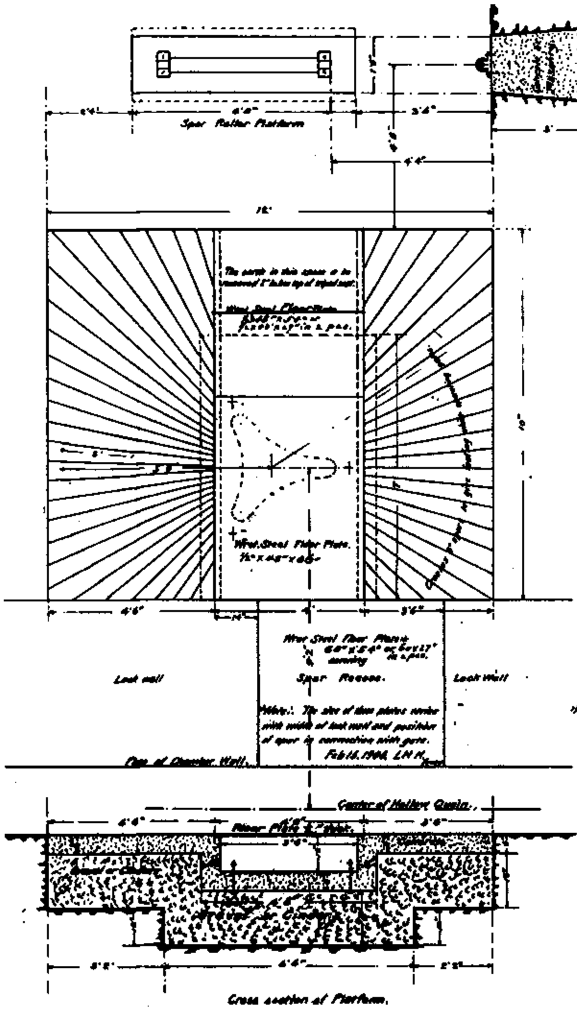
At upper left front gooseneck	1'-3 5/8"
" " " back "	1'-3 5/8"
" " right front "	1'-3 7/8"
" " " back "	1'-3 7/8"
" lower left front "	1'-4 1/4"
" " " back "	1'-3 1/4"
" " right front "	1'-3 1/4"
" " " back "	1'-3 1/2"

Menasha Lock

Left Wall-Upper End	Right Wall-Upper End
Back- 5'-9"	Back- 5'-4"
Front- 6'-5"	Front- 6'-3"
Left Wall-Lower End	**Right Wall-Lower End**
Back- 8'-1"	Back- 8'-8"
Front- 7'-6"	Front- 7'-6"

At upper left front gooseneck	1'-8 1/2"
" " " back "	1'-8 1/2"
" " right front "	1'-8 3/8"
" " " back "	1'-8 1/2"
" lower left front "	1'-9 3/8"
" " " back "	1'-10 5/8"
" " right front "	1'-9 3/8"
" " " back "	1'-11 3/8"

Data for Raising Locks on Lower Fox River, U.S. Engineer Office, Appleton, Wis., Aug. 8, 1923, John M. Hodges, Insp.



BILL OF MATERIAL FOR ONE PLATFORM.

	Platform Proper			Spar Roller Platform, of Concrete
11½	Cubic yards earth excavation.		2¼	Bbls Natural Cement
8	Cubic yards crushed stone or cinders for filling.		⅞	Cubic yard sand
2¼	Cubic yards crushed stone	for concrete.	1¾	Cubic yards crushed stone,
4	Bbls. Natural Cement	for concrete		of Masonry
1	Cubic yard Sand.	for concrete	⅛	Cord Rubble stone.
1¼	Bbls Portland Cement	for top finish.	1	Bbl Natural Cement.
½	Cubic yard sand.	for top finish.	⅞	Cubic yard sand.

IRON: 1 Wrought Steel Floor Plate, checkered pattern, ⅜" x 48" x 54"
* 1 " " " " " " ⅜" x 48" x 66" with triangular hole for tripod
7 Screw Bolts, ⅝" x 10½" long between head & nut with square head & nut for tripod and roller boxes.

GENERAL INSTRUCTIONS TO WORKMEN.

The concrete is to be made of 1 part natural cement, 2 parts sand and 4 parts crushed stone. The top finish one inch thick of 1 part Portland Cement & 2 parts sand.

Lay out the platform 10 feet wide and 12 feet long, longitudinally of the lock, in the proper position. Excavate the earth as shown in the drawing to provide 18 inches filling of crushed stone or cinders under the concrete. Place the filling in layers of about 6 inches, each layer to be well rammed. Place the concrete forming the tripod seat, confining the same with inch boards placed along the edges as shown. The surface of this seat to be slightly depressed in the center and sloping away from lock wall to afford proper drainage.

Set the bolts for securing the tripod in the proper position in the concrete and secure them in position with a templet. Place a form of boards 12 inches wide, in position on this seat to form the sidewalls of the spar recess. A form of 6 inch boards is also to be placed on the out-side edge of platform. Fill these forms to within one inch of the top of lock wall with concrete, and finish with a top dressing of Portland Cement mortar. Scribe creases ¼ inch wide and ¼ inch deep and 6 inches apart in radial lines across concrete, centering on the shaft of tripod. Form a rabbet ⅜ inch deep and 2 inches wide along the edges of spar recess for receiving the edge of cover plate.

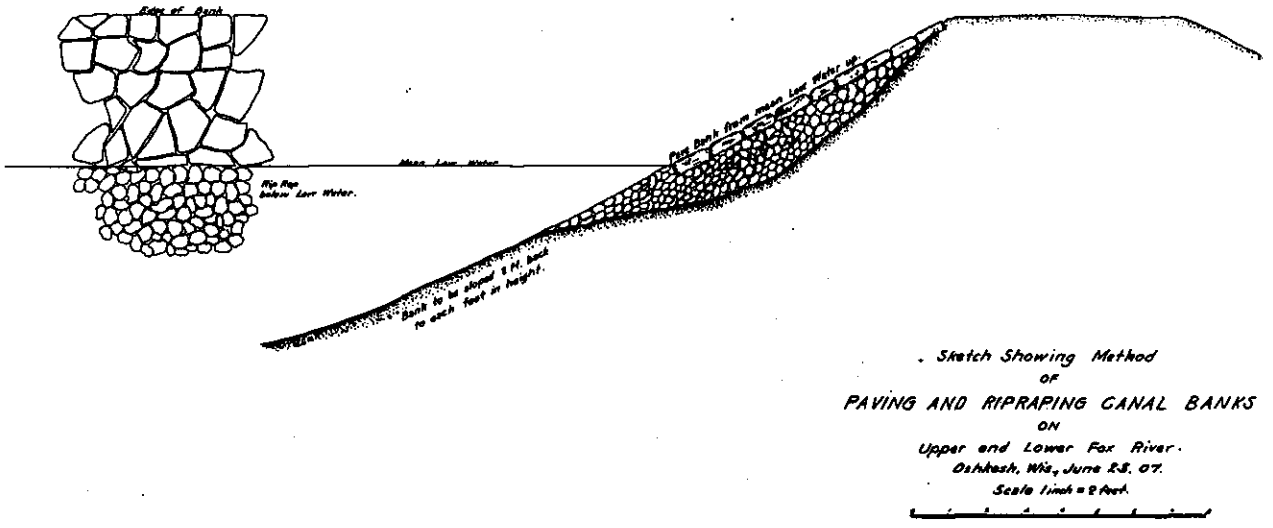
Construct a spar roller platform either of concrete or cement masonry as shown and set split bolts for roller boxes, the height of platform depending on the elevation of the ground.

* Note:. The floor plates ⅜" x 48" x 54" purchased for Appleton 1st Kaukauna 1st and Cedars locks under order No. 238, 1905, and being for the platform at the valve maneuvering gears in each instance, were furnished in two pieces 27 inches wide, making the necessary width of 54". Feb. 15. 1906. L.M.M.

PLAN OF
CONCRETE TRIPOD PLATFORMS.
With Instructions for Construction.
Prepared Under the Direction of
MAJOR J.G. WARREN, CORPS OF ENGINEERS U.S. ARMY,
By L. M. Mann, Assistant Engineer
Oshkosh, Wis., April 9. 1904.
SCALE: 1 INCH = 2 FEET.

United States Engineer Office.
Milwaukee Wis., April 15 1904.
APPROVED. [signature]
Major Corps of Engineers.

Plan of Concrete Tripod Platforms. With Instructions for Construction. L.M. Mann, Assistant Engineer, Corps of Engineers, U.S. Army, April 9, 1904.



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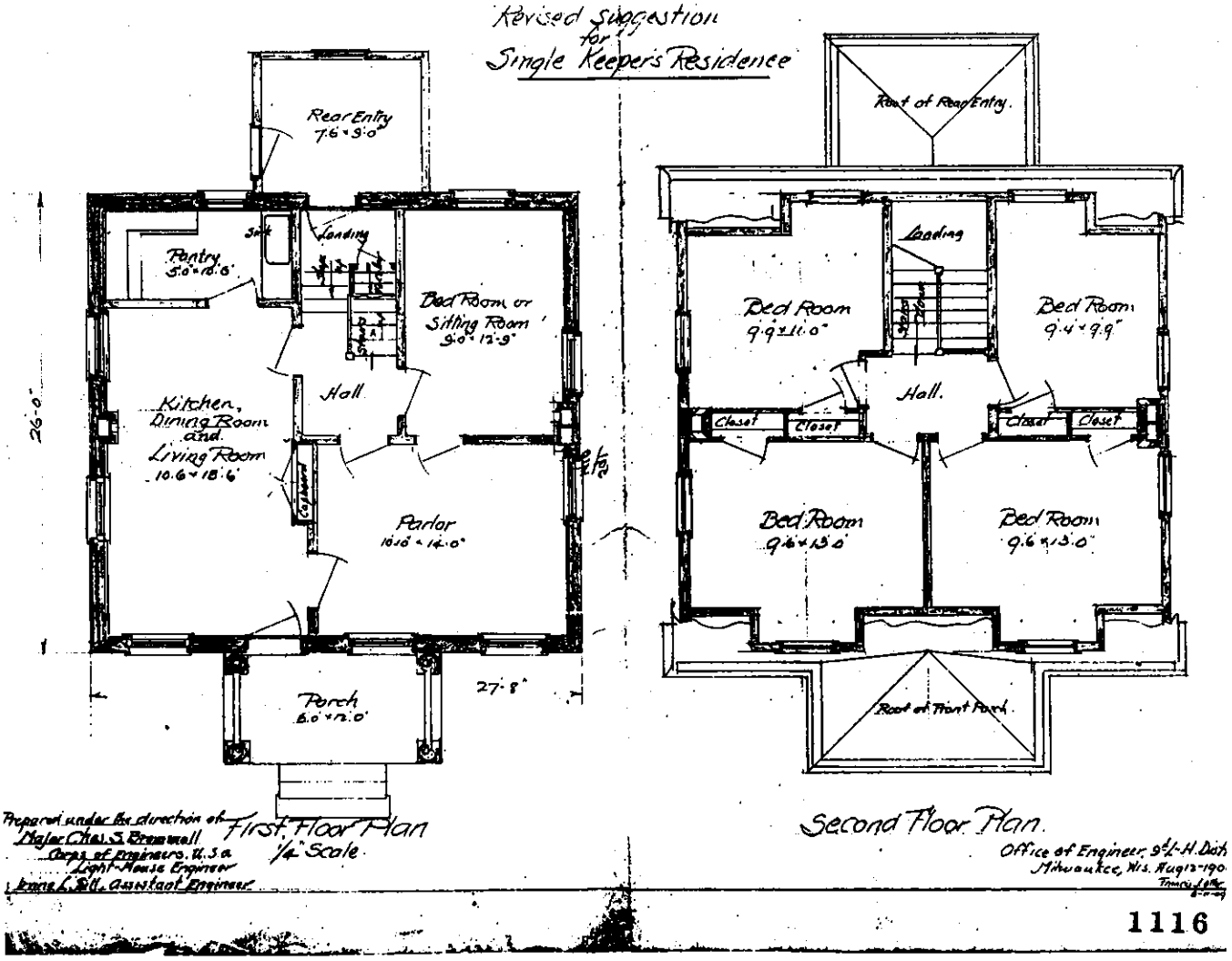
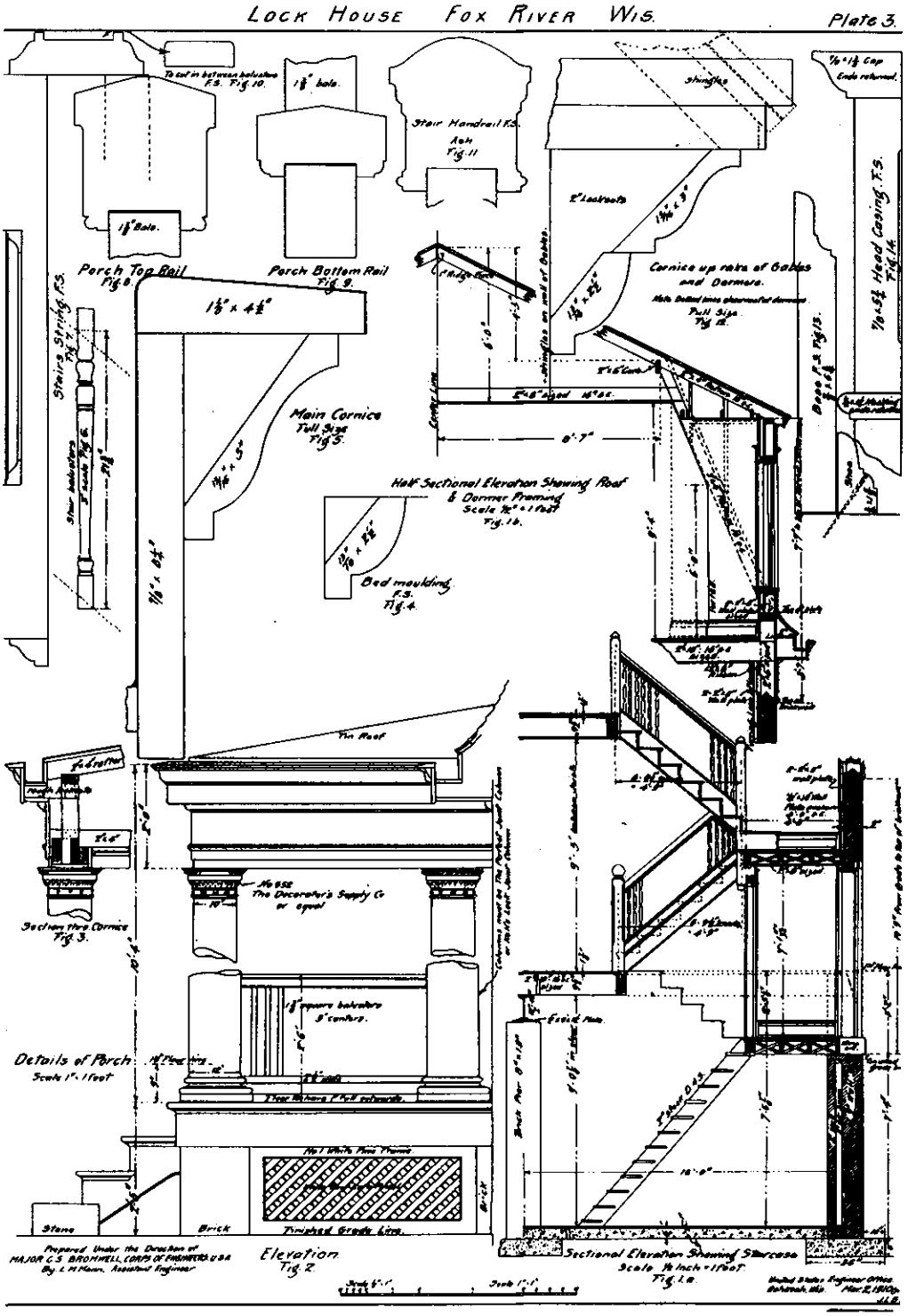
Sketch Showing Method of Paving and Ripraping Canal Banks on Upper and Lower Fox River, John F. Engel, June 23, 1907.



Revised Suggestion for Single Keeper's Residence, Irving L. Sill, Assistant Engineer, Corps of Engineers, U.S.A., August 12, 1909.



Lock House, Fox River, Wis., Plate 3, L.M. Mann, Assistant Engineer, Corps of Engineers, U.S.A., March 2, 1916.